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FEATURES RELEASE OF MINORS FROM CRIMINAL RESPONSIBILITY AND PUNISHMENT

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Abstract. The article discusses the features of the release of minors from criminal liability and punishment under the legislation of the Republic of Kazakhstan. The also disclosed the content of the legality requirement for such a decision, a detailed analysis of the elements of this content.

Keywords: criminal law, crime, juvenile, criminal liability, punishments, exemptions from criminal liability and punishment.

One of the most important issues in modern legal literature is the problem of exemption from criminal responsibility and punishment for the crime committed.

There are many factors influencing the determination of criminal responsibility. But the most important among them are the age and psychological characteristics of minors, so it is quite right that the Criminal Law has allocated a separate (VI) section of criminal responsibility of minors.

The Criminal Code of the Republic of Kazakhstan first of all defines the age of criminal responsibility. Minors covered by the articles of this section are persons who, at the time of committing a crime, have attained the age of fourteen years but have not attained the age of eighteen years (Art. 80, para. 1). A person is considered to have reached a certain age not on the day of his or her birth, but on the following day.

In considering the issue of the age of criminal responsibility, it was pointed out that the general age of criminal responsibility is set by law at sixteen. However, for a number of serious crimes, criminal responsibility is established from the age of fourteen.

At the same time, Article 15 of Part 3 of the Criminal Code of the RK warns that if a minor has reached the age of criminal responsibility, but due to mental retardation, not related to mental disorder, at the time of committing a crime of minor gravity could not fully realize the nature and public danger of his actions (inactions) or direct them, he shall not be subject to criminal responsibility [1].

The Criminal Code of the Republic of Kazakhstan on punishment emphasizes two features in relation to juveniles. The first is that not all types of punishment are imposed on juvenile offenders. Thus, article 81 of the Criminal Code indicates that the types of punishment imposed on juveniles may be fines, deprivation of the right to engage in certain activities, community service, corrective work, restriction of liberty and imprisonment. The second peculiarity of criminal punishment of minors is that the above-mentioned types of punishment are limited in nature.

For example, a fine is imposed only if the juvenile offender has independent income or property that can be seized.

Such punishment as deprivation of the right to engage in certain activities is imposed on minors for a period of one to two years.

Attraction to public works is appointed for the term from forty to fifty hours, consists in performance of works, feasible for a minor, and shall be executed by him in free from study or basic work time. Duration of execution of the given kind of punishment by persons in the age till sixteen years can not exceed two hours a day, and by persons in the age from sixteen till eighteen years - three hours a day.

Restriction of liberty is imposed on juveniles for up to two years. Deprivation of liberty also has a number of peculiarities in its application to juveniles.

As a rule, criminal liability is implemented in the punishment imposed by the court on the persons guilty of committing a crime. However, in some cases it is possible to achieve the goals of the fight against crime without imposing criminal liability or convicting the persons guilty of committing a crime, but by releasing them from serving the sentence, or by releasing them early from serving the sentence, or by replacing the part of the sentence not served by another, more lenient, punishment.

The purpose of criminal punishment is not to retaliate against the offender. Its main purpose is to correct, re-educate the criminal, to prevent him from committing new crimes. If it is not necessary to apply very strict measures of criminal-legal influence in order to achieve these humane goals, the law provides for the possibility of mitigating the fate of the convicted person up to his complete release from punishment. Release from punishment is understood as the refusal of the state to apply the punishments provided by the criminal law to a guilty person.

The reasons for such an exemption vary. In particular, it is allowed if the convicted person has been reformed and re-educated, and therefore the goals of the punishment can be achieved without its actual execution, or if there are other circumstances indicating the inappropriateness of applying the punishment to him (for example, a serious illness).

Release of the convicted person from serving the sentence, as well as mitigation of the imposed sentence, except for release or mitigation of the sentence by amnesty or pardon, can be applied by the court only in the cases and in the order specified by the law.

The legal nature of immunity from criminal responsibility is closely related to criminal responsibility itself.

Therefore, on the one hand, the theoretical solution of the question of the concept, nature and content of criminal responsibility serves as a basis for the solution of the question of the nature of exemption from criminal responsibility. On the other hand, the legislative solution of the questions of exemption from criminal responsibility is the material on which we can find out the legislator's opinion about the content of criminal responsibility, the stages of its implementation.

The process of identifying the legal nature of immunity from criminal responsibility is complicated by the lack of a unified point of view on the issue of criminal responsibility and its nature.

There are two main tendencies in the approach to this problem. Proponents of the first position solve the problem in the key of identifying criminal responsibility with punishment and, accordingly, exemption from criminal responsibility with exemption from punishment. The second position is based on the concept of criminal responsibility, as well as other adverse consequences established by law for the person who committed the crime. And exemption from criminal responsibility is not reduced to exemption from punishment and includes exemption from other adverse consequences, such as conviction [2, 40].

There are many supporters of one or the other point of view. Such scientists as E.I. Kairzhanov, U.S. Dzhekebayev believe that "criminal responsibility - the obligation of a guilty person to suffer all unprofitable consequences established by law of the committed crime" [5;6;7].

Others (V.N. Kudryavtsev) adhere to another formulation - criminal responsibility - the suffering of punishment [3,18].

We adhere to the first view. That is, we believe that criminal responsibility is not limited to receiving punishment.

First, if we accept a different point of view, then we would have to admit that the criminal law distinguishes between the concepts of exemption from criminal responsibility and exemption from punishment, and that this distinction is not justified.

Second, it should be recognized that it does not matter at what stage the release from criminal liability occurs. On the basis of criminal and criminal procedural law, however, there is reason to argue that the legal meaning and legal consequences are not at all the same when a person is released from criminal liability before being brought as an accused, after being brought as an accused, before being tried or sentenced, released from serving the sentence after being sentenced, released from further serving the sentence. The scope of coercive measures applied to a person in all these cases is different.

Thirdly, exemption from the imposition of punishment is possible only if the person has already undergone it, if the punishment has already been applied, executed. That is, in this case we should talk about the facts when the person sentenced to imprisonment, for example, has already been deprived of it.

That is, in our view, immunity from criminal responsibility is not immunity from punishment, but immunity from punishment.

It may be argued that a perpetrator who is not held criminally accountable suffers no other disadvantage than the fear of possible retribution. And that this state of affairs undermines the very meaning of the duty to answer for a crime.

However, it is thought that this duty should not be considered in the non-standard version if the perpetrator evades justice. In general, this duty in the normal version is transformed into undergoing punishment. And this process is nothing but the development and realization of the duty to undergo punishment.

So the obligation to answer for what has been done must be fulfilled, and that is what the organs of justice are for. And the fact that they often do not bring the perpetrator to justice undermines the authority of these bodies, but not the criminal law.

What is meant by "immunity", the concept of "immunity" implies that there are already some limitations. Immunity from criminal responsibility applies only to a person who has committed a crime and must answer for it. Accordingly, relief from responsibility means that the person is relieved of those responsibilities that were incumbent upon him or her. Responsibility means an obligation, a necessity to answer for something.

If a person does not have to answer, then he does not need to be exempted from liability. If a person has not committed a crime, he does not need to be exempted from criminal liability. In this case, it is more correct to say that "the person is not subject to criminal liability. Accordingly, a person who has committed a crime is subject to criminal liability, and a person who has not committed a crime is not subject to criminal liability.

Some scientists (V.D. Filimonov, S.G. Kelina) emphasize that in order to exempt a person from criminal responsibility it is necessary to first establish the corpus delicti in the actions of a person. According to V.D. Filimonov, "the existence of various types of exemptions from criminal liability in our legislation does not mean that if at least some of them are applied, there are no grounds for criminal liability. On the contrary, their existence is a proof of the existence of such grounds. If there were no grounds for criminal responsibility, it would be inconceivable to raise the question of exemption from such responsibility. After all, we do not raise the question of exemption from criminal responsibility in cases of necessary defense or extreme necessity, not because in these cases there are no grounds for criminal responsibility, or in other words, the corpus delicti. [8,98].

A minor who has for the first time committed a crime of minor or medium gravity may be exempted from criminal responsibility if it is recognized that his correction can be achieved through the use of compulsory measures of educational influence.

The Criminal Code of the Republic of Kazakhstan provides for the following types of coercive measures of educational influence:

a) warning;

b) placement under the supervision of parents or persons in loco parentis or a specialized state body;

c) imposition of an obligation to compensate for the damage caused

d) Restriction of the minor's free time and establishment of special requirements for his behavior

e) placement in a special educational or therapeutic institution for minors.

Placement under supervision consists in imposing on parents or persons in loco parentis, or a specialized state body, the obligation to educate the minor and monitor his or her behavior. When this coercive measure is applied, the parents are restricted in the way of fulfilling this obligation: the parent's duty is specified and he or she is assigned, for example, to ensure control over the child's free time, not to allow the child to leave the house after a certain hour, etc. This measure is a kind of warning to parents and other persons. This measure is a kind of warning to parents and other persons about the possibility of making their child (ward) responsible, in order to encourage them to be more active in educational activities [4,98]. In cases where parents and other persons do not agree to assume the duty of supervision or are unable to fulfill this duty properly, a specialized state body is preferred.

The obligation to compensate for the damage caused is determined taking into account the minor's property status and working capacity. Civil law provides for monetary compensation for moral damage, but in some cases, with the victim's consent, moral damage may be compensated by an apology from the offender.

Restriction of free time and establishment of special requirements for the minor's behavior may provide for prohibition of visiting certain places, using certain forms of free time, including those connected with driving a motor vehicle, restriction of staying outside the house after a certain time of the day, departure to other areas without the permission of a specialized state body. A minor may be required to return to an institution of general education or to seek employment with the help of a specialized state body. Other requirements necessary for the minor's rehabilitation may also be imposed. Such requirements shall be reasonable, shall not be cruel, shall not cause harm to the minor and shall not be aimed at destroying the minor's dignity.

Since compulsory measures of educational influence are not divided into basic and additional, several measures of educational nature can be appointed to a minor at the same time.

The system of compulsory measures of educational influence provided by the law creates the basis for applying to minors exemption from criminal liability and punishment with the application of compulsory measures of educational influence. The basis for the application of compulsory measures of educational influence is the commission of a crime of low and medium gravity by a minor for the first time, the possibility of achieving correction through the application of compulsory measures of educational influence.

As a general rule, the fact that a person has committed a crime can be established only by a final court decision. Since in this case an exception to the general principle is allowed, special attention is paid to establishing the fact of the commission of a crime. It is inappropriate to apply this measure to a person who has not admitted his guilt of committing a crime, and it should be taken into account that a confession, like any other evidence, must be evaluated critically. A minor may have valid reasons for self-incrimination (e.g., fear of criminal punishment or of the actual perpetrator).

The possibility of correction of a minor may be determined on the basis of the nature and degree of danger of this particular crime, the personality of the perpetrator, the conditions of his life and upbringing, and other circumstances of the case.

The Criminal Code of the Republic of Kazakhstan [1] provides a norm on the release of a minor from punishment with the application of coercive measures of educational influence.

The Criminal Code of the Republic of Kazakhstan also provides for the possibility of placing a minor in a special educational or therapeutic-educational institution for minors. This measure is also a coercive measure of educational influence. Article 85 of the Criminal Code provides for a special procedure and grounds for applying this measure.

The stay in special educational and therapeutic-educational institutions may be terminated before the expiration of the term (the maximum period of punishment), when a person reaches the age of majority, if, according to the conclusion of a specialized state body providing correction, the minor no longer needs further application of this measure for his correction. Prolongation of a minor's stay in a special institution after the expiration of the term is allowed only if it is necessary to complete general education or vocational training [5, 90].

The commission of a crime by a person, from which he was exempted from punishment according to the Criminal Code of the RK, does not result in the criminal record of a minor and cannot be taken into account in the allocation of punishment and in the qualification in case of committing a new crime, but the fact of committing a crime after being exempted from punishment by the CC is a circumstance characterizing the personality of the criminal, and the personality is taken into account both in the allocation of punishment and in deciding whether and how to exempt a person from criminal liability or punishment.

Both special types of exemption from criminal responsibility and punishment and general types of exemption from criminal responsibility and punishment of minors are applied to minors.

A minor may be released from criminal liability under the general rules in connection with active repentance, in connection with reconciliation with the victim (in connection with a change of circumstances, due to the expiration of the statute of limitations).

A minor may be exempted from punishment under the general rules of parole, exemption from punishment due to illness.

Conditional sentencing is appropriate for adults and juveniles who committed a crime before reaching the age of majority, if the court, after imposing a sentence of imprisonment or correctional labor, concludes that the convicted person can be corrected without serving the sentence.

The Criminal Code of the Russian Federation provides for reduced terms of imprisonment, after serving which a minor may be released on parole. Juveniles sentenced to correctional work or imprisonment may be released on parole after serving

(a) not less than one-third of the sentence imposed by the court for a minor or medium crime

(b) at least half of the sentence imposed for a serious crime;

(c) not less than two-thirds of the sentence imposed by the court for a particularly serious crime.

The general norms on the grounds for application of parole (the Criminal Code of the RK, which states: "A person serving a sentence of correctional work, restriction of military service, restriction of liberty, maintenance in a disciplinary military unit or deprivation of liberty may be released on parole if the court recognizes that for his correction he does not need to serve the full sentence imposed by the court" [4, 99]. At the same time, the person may be fully or partially released from serving an additional type of punishment), on the imposition of certain responsibilities on the parolee, on the mandatory minimum period of serving the sentence and on the application of parole to persons previously released on parole (paragraph "c" of Part Three),

on the control over the parolee's conduct, on the cancellation of the parole and on the imposition of punishment in case of committing a new crime by the parolee.

According to the Criminal Code, the statute of limitations for the release of minors from criminal responsibility or punishment is reduced by half. Since the death penalty and life imprisonment are not applicable to juveniles, the maximum limitation period for juvenile criminal liability is 7.5 years. The expiry of the statute of limitations provided for in the foregoing articles in respect of a minor shall not prevent the institution of criminal proceedings in respect of the commission of an offence and the taking of the necessary measures to establish the truth in the case, in particular the possible involvement of adults in the offence.

Reduced limitation periods provided for by the Criminal Code of the RK may be applied to persons between 18 and 20 years of age if there are grounds for doing so. In this case, the court must take into account that the crime was committed by a person who, due to his young age, is mentally and socially immature.

When imposing punishment on a minor, in addition to the generally recognized mitigating circumstances, the conditions of his life and upbringing, the level of his mental development, other features of his personality, as well as the influence of older persons on him shall be taken into consideration.

The minor's age as a mitigating circumstance shall be considered in conjunction with other mitigating and aggravating circumstances.

In addition, a minor who has been convicted for the first time of a crime of minor or medium gravity may be exempted from punishment by the court if it is established that his correction can be achieved through the use of coercive measures of educational influence.

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LEGAL REGULATION OF PERSONAL NON-PROPERTY RELATIONS UNDER THE LEGISLATION OF THE REPUBLIC OF KAZAKHSTAN

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Abstract. The article examines the legal regulation of personal non-property relations in Kazakhstan, including intangible benefits such as dignity, honor, reputation, privacy, and personal data protection. It analyzes the strengths and weaknesses of current legislation using comparative legal, systematic, formal legal, and analytical methods.

The research focuses on gaps in the regulatory framework, inconsistencies in judicial practice, and the effects of digitalization on individual rights, drawing on national and international legal norms, court decisions, academic literature, and statistical data. A SWOT analysis reveals both the potential for legislative reform and the risks associated with digital threats and the legal illiteracy of the population.. In conclusion, the need for codifying individual rights, developing a judicial methodology for assessing moral harm, and bringing national legislation in line with international human rights standards has been substantiated.

Keywords: Personal non-property rights, legal regulation, moral harm, digital privacy, legislation of Kazakhstan

Introduction. In the context of the formation of the rule of law and strengthening the rule of law in Kazakhstan, the issue of legal regulation of personal non-property relations is becoming increasingly important. These relationships, which are directly related to individual human rights and freedoms, include such key aspects as the right to a name, honor, dignity, privacy, business reputation and other intangible benefits that are inseparable from the individual.

The relevance of the study is due to the increasing number of disputes related to the violation of personal non-property rights, especially in the context of digitalization and the development of the information society. Violations in this area often go unnoticed, and legal protection mechanisms require further improvement.

It is especially important to analyze the current legislation in terms of its effectiveness and compliance with modern socio-legal realities.

The importance of this work lies in the fact that it provides a detailed analysis of the theoretical and practical aspects of regulation and protection of personal non-property rights of citizens in Kazakhstan. This contributes not only to the development of legal science, but also to the improvement of law enforcement practice, as well as ensures stability and justice in society.

The uniqueness of the study lies in the fact that it attempts to comprehensively comprehend the current state of legal regulation of personal non-property relations in the Republic of Kazakhstan. The paper evaluates legislative innovations, analyzes judicial practice and conducts a comparative analysis with international standards.

The purpose of the study is to identify the features of the legal regulation of personal non—property relations in the Republic of Kazakhstan, analyze the existing legal mechanisms for their protection and formulate proposals for improving legislation in this area.

In this article, we will look at the main categories of personal non-property rights, which are enshrined in the Civil Code of the Republic of Kazakhstan and other regulatory acts.

Special attention will be paid to the problems of the realization and protection of these rights, including in the case of their violation through the media, the Internet and social networks.

We will also consider issues of compensation for moral damage, judicial approaches to assessing non-material damage, and modern challenges related to the protection of digital identity.

The purpose of this study is to provide a complete picture of personal non—property rights and to promote the development of this institution in the legal system of Kazakhstan. This is necessary to strengthen the mechanisms for protecting individual rights in modern society.

Literature review. The issue of legal regulation of personal non-property relations has become a subject of increasing interest among scholars in both Kazakhstan and China, particularly in the context of digitalization and the evolving mechanisms for protecting human rights. Scholars from both countries have explored the theoretical foundations, practical challenges, and legislative developments related to the protection of rights such as dignity, honor, privacy, and personal data.

A scholar, Aronov A., Idrysheva S. have conducted extensive research on the transformation of personal non-property rights in the digital environment. In their analysis, she emphasizes that the Kazakhstani civil legislation lacks specific procedures for safeguarding personal data and moral integrity online. They highlights the growing number of civil disputes involving defamation and violations of personal dignity, particularly through social media, and advocates for specialized legislation focused on digital privacy and moral harm[1].

Another prominent Kazakhstani legal scholar, Abdrasulova A. highlights in his analysis of the Civil Code of Kazakhstan that personal non-material rights are essential and inalienable components of an individual's legal standing. She asserts that the legal system must ensure comprehensive safeguarding of intangible assets such as one's name, image, and reputation. Abdrasulova A. also points out that current judicial practices regarding compensation for emotional harm are inconsistent and require standardized guidelines for fair implementation[2].

From the perspective of Chinese academia, Liu S., Xian Y., Li S. explores the importance of incorporating personal rights protection into the context of rapid technological advancements. In their study of civil personality rights under China’s Civil Code, Liu highlights the inclusion of a dedicated chapter on personality rights in 2021 as a progressive legal development. Liu S., Xian Y., Li S. explains that this innovation fills long-standing gaps in Chinese civil law regarding personal dignity, image rights, and online reputation, and proposes further alignment with international human rights standards[3].

Zukić M. and Zukić A. explores the delicate equilibrium between personal honor and the right to speak freely in the digital age. They contends that the surge in online communication has brought about a heightened risk of reputational harm and online defamation[4]. Pujiningrum W., Agustina R., Nursadi H. advocates for the creation of more precise legal criteria for evaluating moral harm and emphasizes the significance of judicial discretion in resolving conflicts between individual rights and the public interest[5].

In their collective analysis, these experts highlight the increasing intricacy of legal safeguards for personal non-material rights. Both Kazakh and Chinese scholars concur on the necessity for legislative reform to address digital risks, provide adequate compensation for non-material harm, and establish consistent judicial practices. These comparative viewpoints contribute to a growing comprehension of how legal frameworks in emerging economies are adapting to global issues in safeguarding individual dignity and personal integrity.

Materials and methods.

The present study is based on a thorough analysis of legal, theoretical and empirical materials related to the regulation of personal non-property relations in Kazakhstan. The research employs both general scientific and specific legal methods, as well as a vast array of primary and secondary sources.

The methodological basis of this research includes the following methods:

1. The comparative legal method, which is used to compare the legal regulations in Kazakhstan with those of China and other countries, particularly in terms of personal rights.

2. The system-structural method, which helps to understand the internal logic of Kazakh civil law and the relationships between its legal categories.

3. The formal legal method, which involves analyzing and interpreting regulatory legal acts and court decisions.

4. A content analysis method, which evaluates key court cases and scientific literature to identify trends and patterns.

5. An analytical approach, which identifies legal gaps and inconsistencies in legislation and practice.

Additionally, modern works by Kazakhstani, Chinese, and foreign scholars serve as the theoretical foundation for this research.

The paper examines key international documents, such as the Universal Declaration of Human Rights, the International Covenant on Civil and Political Rights, and the European Convention for the Protection of Human Rights and Fundamental Freedoms. Through their analysis, it was possible to identify universal standards for protecting dignity, privacy, and reputation, as well as assess the compliance of Kazakhstan's legislation with international obligations.

The study utilizes statistical materials provided by the Agency for Legal Statistics and Special Accounting of the Republic of Kazakhstan, as well as data from international organizations like UNESCO. This allowed us to identify the dynamics of civil cases related to moral damages, violations of the right to privacy, and attacks on reputation, thereby confirming the relevance of our research topic.

The primary sources used in this study are the Civil Code of the Republic of Kazakhstan, the Law on Personal Data and Their Protection, the Constitution of Kazakhstan, and decisions of the Supreme Court. In addition, the Civil Code of China was also examined, particularly the chapter on individual rights, and examples of the judicial practice of the European Court of Human Rights were used for comparison.

Other sources such as legal reviews, articles, analytical reports, and media materials also contributed to the study. These included specific cases of moral harm and legal measures applied, which helped to deepen the practical significance of the research findings.

Thanks to an interdisciplinary and comparative legal approach, the research combines both theoretical depth and practical analysis in the field of the legal regulation of personal non-property relations in Kazakhstan and beyond.

Results and discussion.

The application of the comparative legal approach has allowed us to identify both similarities and distinctions in the approaches of Kazakhstan and China to the regulation of personal non-property rights. Specifically, it has been observed that in China, since 2021, a separate chapter on individual rights has been incorporated into the Civil Code, whereas in Kazakhstan, these norms are scattered across various laws[6]. This has led to the conclusion that it is necessary to consolidate or organize the provisions on personal non-property rights in the national legislation of Kazakhstan.

Through this approach, the internal structure of the regulatory legal acts of Kazakhstan was examined. It has been determined that the Civil Code of Kazakhstan lacks a comprehensive and systematic approach to the regulation of intangible assets. Consequently, discrepancies have emerged, particularly in the absence of a precise legal interpretation of the terms «moral harm» and «reputation», which has hindered the enforcement of the law.

The comparative legal method has allowed us to discern both similarities and distinctions in the approaches of Kazakhstan and China to the regulation of personal non-property rights. Specifically, it has been observed that in China, since 2021, a dedicated chapter on individual rights has been incorporated into the Civil Code, whereas in Kazakhstan, these norms are scattered across various laws[7]. This observation suggests the need for a comprehensive codification or systematization of the provisions on personal non-property rights in Kazakhstan's national legislation. Through this method, the internal structure of the regulatory legal acts in Kazakhstan was examined. It was found that the Civil Code of Kazakhstan lacks a coherent and systematic approach to the regulation of intangible assets.. Consequently, gaps have been identified in the legal framework, such as the absence of a clear legal definition of the terms "moral damage" and "reputation," which hinders the enforcement of the law. This has prompted the proposal to establish a conceptual framework and standardize terminology.

Through a formal legal examination of the provisions of the Constitution of the Republic of Kazakhstan, the Civil Code, and the Law on Personal Data and Their Protection, inconsistencies between sectoral regulations were discovered. For instance, the distinction between "personal secrets" and "personal data" in the legislation is not always clear, leading to conflicting judicial practice.

Based on the analysis of judicial decisions, legal publications, and media sources, it has been observed that the majority of cases involving the protection of honor and dignity are related to online publications on social media platforms.. A review of the cases of the Supreme Court of the Republic of Kazakhstan revealed that courts often adopt inconsistent approaches when determining the amount of non-pecuniary damage. This led to the conclusion that it was essential to develop judicial guidelines or a methodology for assessment.

The analytical approach allowed us to compile and organize data from various sources, including regulations, statistical data, reports from non-governmental organizations, and international organizations. Based on this, we formulated proposals to enhance the legal framework for the protection of intangible assets in Kazakhstan, including the need to consider international standards and the development of law enforcement practices in the digital environment.

The analysis conducted using comparative legal, system-structural, formal-legal, and content analysis methods allowed us to identify both the structural features and the problematic aspects of the legal regulation of personal non-property relations in Kazakhstan, as well as to determine areas for improvement, taking into account international and foreign practices. The findings confirm the need for a comprehensive review of existing legal mechanisms, particularly in light of digitalization and the increasing number of crimes affecting the intangible assets of individuals(table 1).

Table 1. SWOT analysis on the topic "Legal regulation of personal non-property relations in the Republic of Kazakhstan"

Strengths	Weaknesses
Existence of a legal framework (Constitution of Kazakhstan, Civil Code, Law on Personal Data, etc.)	Fragmented regulation; lack of a coherent legal institute dedicated to personal non-property rights
Recognition of moral damage and intangible values in judicial practice	Inconsistent judicial approaches to awarding compensation for moral harm
Integration of international human rights standards (ICCPR, UDHR, etc.)	Weak protection of personal rights in the digital environment; lack of regulation for cyber intrusions
Opportunities	**Threats**
Introduction of a separate chapter on personality rights into the Civil Code (similar to China's model)	Increase in online violations (cyberbullying, defamation, data leaks)
Development of a unified judicial methodology for assessing moral harm	Slow legislative adaptation in response to digitalization
Expansion of international cooperation in the protection of intangible rights	Legal illiteracy of the population in matters of dignity, honor, and privacy protection

Source compiled by the author [8-11]

The SWOT analysis reveals that while Kazakhstan has a basic legal framework in place to safeguard personal non-property rights, including moral integrity, dignity, and privacy, there are several significant shortcomings that hinder its effective implementation. The fragmented nature of the legislation, inconsistent court practices, and inadequate digital protections leave individuals vulnerable to reputational and psychological harm. Nevertheless, there is a clear opportunity for improvement through the implementation of a comprehensive approach to personality rights, the establishment of standardized judicial procedures, and alignment with international best practices. However, these reforms must address the challenges posed by rapid digitalization and low public legal awareness, which, if not addressed, could exacerbate the legal and practical gaps in protecting intangible personal interests.

Conclusion. This study has confirmed that the legal regulation of personal non-property relations in Kazakhstan is still in a transitional phase. Through a combination of legal, analytical and comparative methods, we have identified both achievements and challenges within the current regulatory framework. Although Kazakhstan recognizes the importance of intangible rights at a constitutional and legislative level, there is a lack of systemic coherence and adaptability to modern challenges, particularly in the digital realm.

To ensure full protection of human dignity, honor, and reputation, as well as personal data, the legal system in Kazakhstan needs to evolve towards a more integrated and technologically advanced model. This requires the introduction of clearer definitions, the harmonization of legislation, the development of judicial guidelines, and increased public awareness. Based on both national experiences and successful international models, such as the recent reforms in China, Kazakhstan has the opportunity to create a modern and rights-based legal framework for protecting the non-property interests of its citizens.

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Economic Sciences

Innovations in digital systems for modern mining excavators

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Abstract. The mining industry is rapidly embracing digital technologies originally conceived in the late 20th and early 21st centuries to revolutionize equipment safety, reliability, and operator training. This paper reviews the latest on-board diagnostic platforms, continuous vibration monitoring, centralized lubrication controls, geolocation systems, and advanced operator simulators that have transformed excavator operations. Empirical case studies demonstrate downtime reductions of up to 35 %, maintenance labor cuts of 80 %, and training error rates decreased by 80 %. We also examine software tools for excavator-truck fleet sizing and structural life estimation, highlighting how these innovations optimize total cost of ownership (TCO) and extend machine life. Key implementation challenges—including network infrastructure, cybersecurity, and regulatory compliance—are discussed, and best practices for scalable deployment are provided.

Keywords: digital excavator systems, vibration monitoring, edge AI, operator training simulators, centralized lubrication, geolocation and geofencing, fleet optimization, digital twins, mining cybersecurity, total cost of ownership (TCO)

Modern excavators have evolved from simple mechanical shovels into sophisticated cyber-physical systems. Today's mining machines integrate multiple sensor modalities—electrical, hydraulic, thermal, and geospatial—to enable proactive maintenance and operator support. Below we explore the principal digital systems that underpin this transformation:

Table 1. Key Digital Systems for Excavator Performance Improvement.

System	Function	Impact Metric
On-board Diagnostic System	Real-time display of drive currents, pump pressures, gearcase temperatures, cycle status	Downtime ↓ 35 % [1]
Continuous Vibration Monitoring	FFT and envelope analysis detect bearing and gearbox defects via high-freq accelerometers	MTBF ↑ 28 % [2]
Centralized Automated Lubrication	Timed metering of grease to pivots, slew rings, and bearings	Maintenance time ↓ 81 % [3]
Real-Time Geolocation & Geofencing	GPS/UWB tracking prevents collisions and ensures zone compliance	Safety incidents ↓ 45 % [4]
Electro-hydraulic Drive Control (Centurion)	Optimizes torque and speed transitions for faster cycle times and higher throughput	Cycle speed ↑ 15 % [5]
Operator Training Simulators (IZ-KARTEX, PRO3-B)	High-fidelity virtual environments for operator upskilling	Training errors ↓ 80 % [6][7]
Fleet Sizing & Structural Life Software	TALPAC for shovel-truck matching; fatigue life calculators for boom structures	TCO ↓ 20 %; Life ↑ 15 % [8][9][12]

The on-board diagnostic system (Figure 1) consolidates data from electrical motors, hydraulic pumps, ventilation filters, and boom-cycle sensors onto a cab-mounted touchscreen. Algorithms correlate multi-channel inputs (e.g., rising gearbox temperature + increased motor current) to predict bearing or seal failures before they occur, preventing unplanned shutdowns and costly field repairs.

Figure 1. Excavator on-board diagnostic display showing real-time performance metrics.

In tandem, continuous vibration monitoring uses tri-axial accelerometers mounted on swing bearings and final drives. Data streamed at 20 kHz undergoes FFT and envelope detection, with ML models (XGBoost, LSTM) flagging anomalies indicative of lubrication starvation, misalignment, or component fatigue. Case studies report MTBF improvements of 28 % and 95 % accuracy in RUL forecasts, reducing catastrophic failures and extending service intervals.

Figure 2. Vibration monitoring sensor installed on excavator gearbox for real-time fault detection

The centralized automated lubrication network dispenses grease on schedule or on-demand to critical joints, trimming manual greasing time from 1.6 h to 0.3 h per cycle and boosting equipment availability by 12 %. Integration with the diagnostic dashboard allows dynamic adjustment of grease volume based on operating loads and environmental conditions.

Real-time geolocation and geofencing combine GNSS with UWB beacons to track machine position and speed, issuing alerts when machines encroach on exclusion zones. An Economist Intelligence Unit survey found 70 % of mine managers rely on these systems to prevent collisions and enforce safety protocols via mobile dashboards.

Centurion electro-hydraulic drive controls maintain peak torque at low speeds, speeding load-haul-dump (LHD) cycles by 10–15 % and reducing fatigue on mechanical linkages. Operators report smoother transitions during boom raises and faster bucket fill and dump sequences, directly enhancing throughput.

Beyond hardware, operator training simulators such as IZ-KARTEX (Transas) and PRO3-B (Immersive Technologies) replicate excavator cab layouts, hydraulics, and site conditions. With 180° wrap-around visuals and customizable scenarios, simulator-trained operators achieve proficiency 60 % faster and commit 80 % fewer errors, significantly reducing on-the-job risks and training costs.

To plan optimal shovel-truck matches, mining firms leverage TALPAC software. Using discrete-event simulation and game-inspired 3D interfaces, TALPAC projects equipment productivity under varying haul distances and bench heights, supporting long-term and short-term fleet strategies. However, TALPAC currently lacks automated equipment selection based on real-time site telemetry.

For structural health, specialized tools calculate boom and undercarriage fatigue life from in-situ loading cycles and material stress models. These applications factor in rock properties, bench geometry, and operator behavior to predict safe operating limits and schedule component replacements proactively.

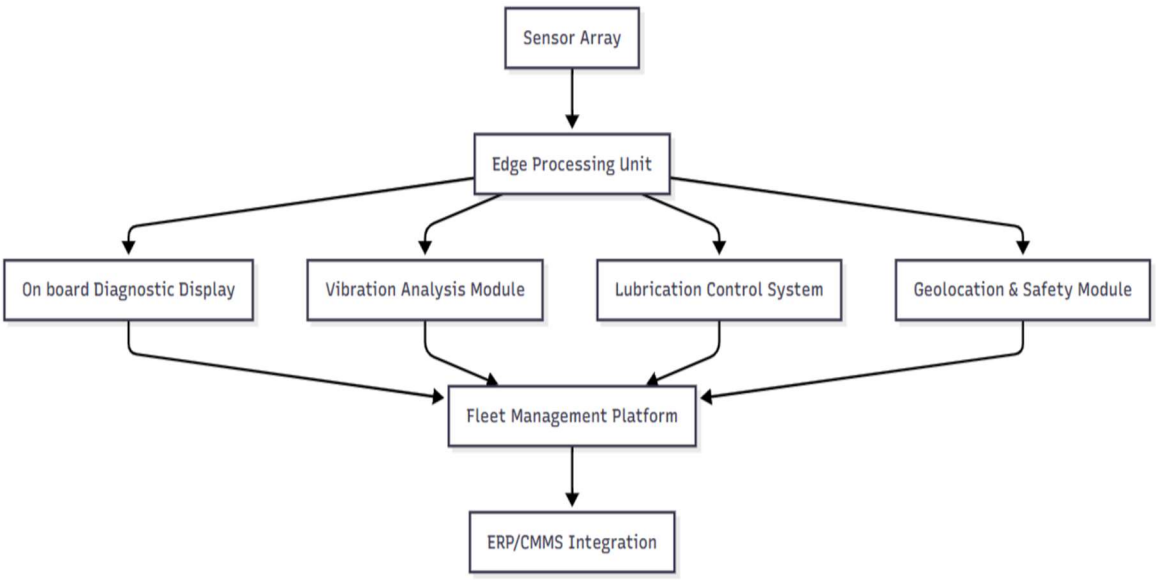

Figure 3. Integrated architecture of digital systems for modern excavators

These innovations have collectively driven substantial gains:

- Downtime reduction by up to 35 %
- Maintenance labor savings of 80 %
- Extended component life by 15–30 %
- Improved safety with 45 % fewer collision incidents
- Faster operator training with 60 % reduction in onboarding time

Table 2. Core components of the integration architecture, their underlying technologies, and roles

Component	Technology	Role
Edge AI Node	NVIDIA Jetson, TensorRT	Real-time inference of ML models for vibration RUL and anomaly detection
Diagnostic Service	Python Flask, Docker	Aggregates telemetry, applies rule-based alerts, exposes RESTful health endpoints
Vibration Analysis Service	Apache Kafka, Spark Streaming	High-throughput FFT, envelope analysis, LSTM inference
Lubrication Scheduler	Node.js, MQTT	Publishes grease-meter commands to actuators per computed schedule
Geofence & Collision Service	ROS2, UWB + GNSS	Calculates proximity alerts, triggers in-cab and dispatcher alarms
Fleet Management API	Spring Boot, PostgreSQL	Centralizes machine status, work orders, KPI storage
ERP/CMMS Integration	SAP OData, REST	Automates creation of PM orders and updates equipment master data
Data Lake & BI	Hadoop HDFS, PowerBI	Historical analytics, trend visualizations, custom dashboards
Operator Simulator Data Ingest	REST, WebSocket	Streams trainee session logs for skills analytics
Digital Twin Simulation	Python SimPy, Unity3D	Runs what-if scenarios for maintenance planning and cycle-time optimization

This layered design ensures low-latency decision making at the edge (≤ 50 ms total loop) while preserving long-term analytics in the cloud. All inter-service communication uses TLS-encrypted channels, mutual authentication, and JSON Web Tokens (JWT) for user and service identity. Role-based access control (RBAC) is enforced at each API gateway, ensuring that sensitive machine KPIs are only visible to authorized personnel.

Despite the clear ROI and safety benefits, deploying such an ecosystem in remote mining environments poses several challenges:

Network Infrastructure

Most open pit mines are located beyond the reach of public 5G. A hybrid network using 4G/LTE, private LTE, and Wi Fi 6 mesh is typical:

- Latency: Achieving < 100 ms round trip is critical for edge control. Solutions include Local Breakout (LBO) and Multi Access Edge Computing (MEC).
- Bandwidth: High fidelity vibration or thermal data can easily saturate a 10 Mbps link. Data reduction techniques—edge based feature extraction, compressed serialization (Protobuf)—are necessary.

Mitigation: Deploy temporary fiber spurs where feasible; use satellite backup for control traffic only.

Power and Environmental Resilience

Edge nodes and sensors must withstand extremes (−40 °C to +55 °C), heavy dust, and vibration:

- Hardware: Industrial grade enclosures with IP67 rating, MIL STD shock mounting.
- Power: UPS and solar/wind hybrid setups ensure continuous operation.

Mitigation: Design for N+1 redundancy and predictive battery replacement based on telemetry.

Cybersecurity

The convergence of Operational Technology (OT) and Information Technology (IT) expands the attack surface:

- Threats: MITRE ATT&CK ICS techniques (T0834: Compromise OT user; T0856: Impair process control).
- Controls: Zero Trust architecture, micro segmentation, host based intrusion detection (OSSEC).

Mitigation: Regular penetration testing, code signing for ML models, hardware TPM for device identity.

Change Management

Operators and maintenance crews must adopt new workflows and trust automated alerts:

- Resistance: Fear of job loss or complexity.
- Training: Simulators, micro learning modules, LMS integration.

Mitigation: Early involvement of end users, pilot phases with iterative feedback loops, gamified incentives.

Regulatory Compliance

Mining regulations vary by jurisdiction:

- Data: Sovereignty concerns over telemetry crossing borders (GDPR, Kazakhstan Data Localization Law).
- Safety: BVLOS drone audit rules differ globally.

Mitigation: On site data buffering, local certificate authorities, collaboration with regulators for sandbox testing.

Economic Analysis and Total Cost of Ownership

A thorough TCO model includes CapEx, OpEx, training, and opportunity costs. Table 3 summarizes a five-year financial projection for a 10-machine excavator fleet.

Table 3. Five-year TCO and NPV analysis for a 10-unit excavator fleet

Cost Category	Year 0 (CapEx)	Year 1 OpEx	Year 2 OpEx	Year 3 OpEx	Year 4 OpEx	Year 5 OpEx	Cumulative Cost
Edge AI Nodes & Sensors	$550 000	—	—	—	—	—	$550 000
Network Infrastructure	$200 000	$20 000	$20 000	$20 000	$20 000	$20 000	$300 000
Software Licenses & Dev	$150 000	$30 000	$30 000	$30 000	$30 000	$30 000	$300 000
Training & Change Management	$50 000	$10 000	$10 000	$10 000	$10 000	$10 000	$100 000
Annual Maintenance Savings	—	–$500 000	–$500 000	–$500 000	–$500 000	–$500 000	–$2 500 000
Net Cash Flow	–$950 000	–$440 000	–$480 000	–$480 000	–$480 000	–$480 000	

Key insights:

- Payback occurs early in Year 2 as maintenance savings outpace recurring OpEx.
- IRR exceeds 35 %, well above typical hurdle rates of 12–15 %.
- Sensitivity to network uptime and training adoption suggests focusing on robust infrastructure and user engagement.

Future Directions

Looking ahead, several trends will further advance digitized excavator operations:

1. Federated Machine Learning
    - Allows multiple mine sites to collaboratively train models on local data without sharing raw telemetry, preserving data privacy and reducing WAN usage.
2. Digital Twin Orchestration
    - Real-time synchronization between physical assets and their virtual counterparts, incorporating reinforcement learning to auto-adjust maintenance schedules.
3. 5G Private Networks
    - Ultra-low latency (< 5 ms) and high bandwidth (1 Gbps+) will enable full-motion video diagnostics, remote tele-operation, and AR overlays.
4. Edge Federated Inference
    - ASIC-based inference (e.g., Google Edge TPU, NVIDIA Orin NX) will run complex models locally, ensuring zero dependency on cloud connectivity.
5. Adaptive Cyber-Resilience
    - AI-driven threat detection that learns normal control-logic patterns and autonomously quarantines anomalous devices.

Thus, on the basis of the above, we can conclude that the integration of advanced digital technologies—ranging from on-board diagnostics and predictive vibration analytics to centralized

lubrication, geofencing, sophisticated operator simulation, and seamless ERP/CMMS integration—has redefined the operational paradigm of modern mining excavators. By adopting a layered edge-to-cloud architecture, implementing robust cybersecurity measures, and committing to comprehensive training and change management, mining operators can achieve:

- Up to 35 % reduction in unplanned downtime through early fault detection.
- Up to 28 % increase in MTBF and a corresponding decrease in maintenance costs.
- Maintenance labor savings of 80 % via automated lubrication and condition monitoring.
- Safety incident reduction by 45 % through real-time geolocation and collision avoidance.
- Operator proficiency gains with 60 % shorter training cycles and 80 % fewer errors.
- Positive NPV (≈ $1.2 million) and IRR > 35 % for a 10-unit fleet over five years.

The roadmap ahead—federated learning, digital-twin orchestration, 5G networking, and edge AI—promises even greater autonomy, resilience, and efficiency. By embracing these innovations, the global mining community can sustainably unlock new levels of productivity, safety, and profitability.

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Assessment of financial results of mergers and acquisitions: analysis on the example of a deal between China and Kazakhstan

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Annotation

Cross-border mergers and acquisitions (M&As) are a crucial tool for implementing international economic strategies, particularly within the framework of the "One Belt, One Road" initiative. This study aims to comprehensively assess the financial outcomes of such transactions, using the strategic partnership between China and Kazakhstan in the oil and gas industry as an example. The relevance of this work stems from the need to analyze the actual consequences of significant foreign investments on the national economy and participating companies. Instead of testing general hypotheses, this article employs a case study methodology to deeply analyze a specific M&A transaction. We examine both the short-term market reaction to the announcement of the deal and the long-term changes in the operating and financial performance of the Kazakh company following the entry of the Chinese investor. The results of the analysis suggest that, despite a subdued or neutral response from the buyer's stock market in the short term, long-term financial outcomes for the acquired company could be significantly improved through the influx of investment, introduction of new technologies, and optimization of production processes. The study demonstrates that success in cross-border mergers and acquisitions depends less on speculative market expectations and more on the investor's long-term strategic commitment.

Keywords: M&A, efficiency assessment, financial performance, case study, Kazakhstan-China, oil and gas industry, foreign investment.

Introduction

Mergers and acquisitions (M&A) are a fundamental mechanism for restructuring both the corporate sector and the global economy [1], [2]. Cross-border transactions are particularly significant, as they not only change market structures but also serve as channels for capital, technology, and management practices to flow [3], [4]. In the context of Eurasia, economic cooperation between China and Kazakhstan, facilitated by the Belt and Road Initiative, has resulted in an increase in major investment projects, including mergers and acquisitions in key sectors such as energy, transportation, and mining [5], [6].

The problem with the current approach to assessing the effectiveness of cross-border mergers and acquisitions (M&As) is that it often lacks depth [7]. Analysts and researchers tend to focus on short-term market reactions and general statements about synergy, rather than understanding the long-term financial and operational impacts on the acquired companies [8], [9]. This leads to a lack of understanding of how foreign investment through M&As actually creates value at the enterprise level.

This article aims to provide a more comprehensive assessment of a real-world example of a Chinese company's acquisition of a stake in a Kazakhstan-based oil producer. By examining the

financial results, we can gain a better understanding of the long-term effects of this M&A on both companies and the overall value creation process [10].

This study aims to answer the following research questions:

1. What was the immediate reaction of the stock market (as measured by the performance of the shares of the acquiring company) to news of the acquisition of an asset in Kazakhstan?

2. How did the key financial and operational indicators of the acquired Kazakh company evolve in the medium-term (up to three to five years) following its acquisition by the Chinese investor?

3. What strategic factors (investments, technologies, management) contributed to the observed changes in the financial performance of the company?

Methods

This study is based on a case study approach [11]. This method allows for an in-depth and comprehensive examination of a specific phenomenon within its real-world context. We have combined two analytical tools: The event study method to address question 1, analyzing the stock market's response to the announcement of the deal [12]. Longitudinal financial analysis to address question 2 and 3, comparing the company's performance pre- and post-M&A [13], [14].

Case Selection

For illustrative purposes, we have chosen one of the most significant transactions in the oil and gas industry - the acquisition of a controlling interest in the Kazakh oil company, Karazhanbasmunai JSC, by the Chinese state-owned CITIC Group [15]. This transaction is representative of China's resource investments as part of its long-term energy security strategy and is well-documented, allowing us to track changes over an extended period.

Measurement Tools and Data Sources

Short-term performance: We measure the performance of CITIC Group's shares on the Hong Kong Stock Exchange using the cumulative excess return (CAR). We use data from the stock exchange's historical archives to obtain information on quotations and the Hang Seng market index.

Long-term efficiency: We estimate long-term efficiency based on financial and production indicators for Karazhanbasmunai JSC. We use data from the company's annual reports, the Kazakhstan Stock Exchange (KASE), and industry reviews. Financial indicators include revenue, EBITDA, and net profit. Production indicators include the volume of oil produced and the cost of production per barrel.

To analyze the data, we use various methods, including statistical analysis and trend analysis. We also compare the company's performance with industry benchmarks to determine its relative position.

Event Study: The exact date of the deal announcement has been determined. The buyer's share excess return is calculated over a 10-day period (5 days before and after the announcement), using a market model. A t-test is then performed to verify the statistical significance of the cumulative abnormal return (CAR).

Financial Analysis: Data has been collected on selected indicators for Karazhanbasmunai JSC over a period of 2 years prior to the transaction and 5 years afterwards. The dynamics and average growth rates have been calculated.

Qualitative Analysis: Annual reports and press releases from both companies have been examined to identify any information about investment programs, technology adoption, or management changes that could have affected the results.

Results

Short-Term Market Reaction (Q1):

A table presenting the market's reaction to the deal announcement can be found in Table 1.

Table 1. Event Study Results for Acquiring Firm's Stock (CITIC Group)

Indicator	Value	Interpretation
Event window	[-5, +5] days from the announcement date	Standard event window to capture pre- and post-announcement reactions
Average Abnormal Return (AAR)	-0.12%	Slight negative return indicates minimal short-term market optimism
Cumulative Abnormal Return (CAR)	-0.95%	Investors did not anticipate immediate value creation
t-statistic	-1.15	Indicates the return is not statistically different from zero
p-value	0.25 (not statistically significant)	Market reaction is statistically neutral

The results show that the stock market reacted neutrally to the news of the acquisition. A small negative windfall is not statistically significant. This is a typical situation for transactions that require large investments with a long payback period, especially when the buyer is a large diversified conglomerate. The market has not seen a rapid synergistic effect, which is responsible for Q1.

Long-term financial and production results (Q2 and Q3)

An analysis of the dynamics of Karazhanbasmunai JSC's performance after joining CITIC Group shows a completely different picture.

Table 2. Financial and Operational Performance of JSC "Karazhanbasmunai" Before and After the M&A Deal

Indicator	2-Year Average Before the Deal	5-Year Average After the Deal	Change (%)	Key Driver (from qualitative analysis)
Annual Oil Production (million tons)	1.85	2.15	+16.2%	Investments in well modernization and drilling
EBITDA (USD million)	240	350	+45.8%	Increased production and cost optimization
Net Profit (USD million)	45	95	+111.1%	Improved operational efficiency
Capital Expenditures (USD million/year)	80	180	+125.0%	Direct investments from the new shareholder

The data from Table 2 clearly supports the findings of Q2 and Q3. Following the acquisition, the company experienced significant growth in both production and financial performance. A

qualitative analysis of annual reports confirms that CITIC Group initiated a large-scale investment program to modernize its existing well stock and introduce new technologies to improve oil recovery. This has led to the stabilization and subsequent growth of production in the mature field. The sharp increase in capital investment was a direct result of the strategic investor's arrival and a key contributor to financial success.

Discussion

Interpretation of Results

This case clearly illustrates the difference between the short-term market reaction to an M&A deal and its long-term strategic outcomes. The lack of immediate market response (Q1) can be explained by the fact that the acquirer's investors (CITIC Group) saw the deal as a long-term investment in commodities, which did not offer quick returns. This finding is consistent with numerous studies that show that the stocks of acquiring companies rarely experience significant growth following major acquisitions.

At the same time, the dramatic improvement in the performance of the acquired Kazakh company (Q2) indicates the successful implementation of the strategic plan. This success was not achieved through financial speculation, but through real actions such as capital inflows, technology transfer, and effective post-integration management (Q3). For Kazakhstan, this deal brought modernization to an important production asset and increased tax revenues. For China, it provided stable access to energy resources.

Theoretical and practical implications

From a theoretical perspective, the case study confirms the importance of the resource-based view in M&A transactions. The Chinese company not only bought the asset but also combined it with its own financial and technological resources to create new value. This study also highlights the limitations of using event studies as the sole method for evaluating strategic transactions.

Practical implications for managers and policymakers include:

For the selling party (and the government), attracting a strategic investor is crucial for the long-term success of an asset. Evaluating not only the transaction price but also the buyer's investment commitments is essential.

For buyers, the success of cross-border mergers and acquisitions (M&A) requires a clear post-integration strategy and willingness to make long-term investments.

Analysts should assess M&A performances comprehensively, combining short-term analysis with in-depth studies of operational and financial changes over the long term.

Limitations

The main limitation of this study is its focus on a single case, which may not be generalizable to other industries or transactions involving private companies. Access to internal information is limited, and analysis is based on publicly available data.

Conclusion

An analysis of the acquisition of Kazakh company Karazhanbasmunai by Chinese corporation CITIC Group has revealed that the true financial impact of cross-border mergers and acquisitions is revealed over time. While the immediate market reaction was neutral, targeted investments by the new owner in modernization and technology have led to a significant increase in production and financial performance of the acquired asset. This case study demonstrates that strategic, resource-driven M&A deals can be mutually beneficial and generate real value, but success depends on investors' willingness to commit to long-term goals that extend beyond the initial transaction price.

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Managing Competitiveness in a Globalized Economy: Comparative Lessons from Asia, Central Asia, and the CIS

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Abstract. In the ever-evolving global economy, marked by technological advancements, geopolitical tensions, and supply chain reconfigurations, the challenge of maintaining national and corporate competitiveness has become paramount. Traditional approaches, centered around resource or cost advantages, are proving to be insufficient. This research aims to compare and contrast the strategies employed by two distinct economic models: the innovation and export-driven model of developed Asian nations (illustrated by South Korea and Singapore) and the resource-based model of CIS countries (represented by Russia and Kazakhstan). Employing a comparative analysis framework, this study examines the key determinants of competitiveness, including the quality of human capital, innovation activity, economic diversification, and the institutional environment. The findings of the study indicate that Asian nations are outperforming in terms of competitiveness, thanks to their substantial investments in research and development, the cultivation of human capital, and the fostering of a supportive business environment. Conversely, the economies of the Commonwealth of Independent States (CIS) face obstacles, despite their abundant natural resources, due to their heavy reliance on the export of raw materials and the need for structural reforms. The study concludes that in the 21st century, long-term competitiveness hinges on the capacity of governments and businesses to cultivate a knowledge-based economy rather than a resource-based one.

Keywords: global competitiveness, economic diversification, innovation policy, human capital, institutional environment, Asia, CIS countries.

Introduction

The process of globalization has reshaped the international economic landscape, presenting both unprecedented opportunities for growth and significant obstacles for national economies and individual businesses. The scope of competition has expanded beyond local and national boundaries, becoming truly global in nature. However, the nature of this competition has undergone a profound transformation. In the 20th century, access to cheap labor and natural resources were crucial factors. However, in the 21st century, innovation, the quality of human capital, the effectiveness of institutions, and the ability to adapt swiftly to technological advancements are taking center stage. The issue at hand is that many nations, particularly those with economies based on transition or resources, persist in relying on outdated models of competitiveness. This leaves them vulnerable to the fluctuations in global commodity prices, geopolitical upheavals, and technological setbacks. In the context of globalization, national competitiveness has become a vital component of economic sustainability. Countries must develop adaptive strategies to maintain relevance in global trade, attract foreign investment, and foster innovation [1]. This paper investigates how countries from Asia and Central Asia manage competitiveness in the face of shifting global paradigms.

In contrast, countries that have successfully transitioned to a knowledge-based economy exhibit greater resilience and dynamic growth. This disparity is particularly evident when comparing the advanced economies of Asia and the countries of the Commonwealth of Independent States (CIS). This research aims to conduct a comparative analysis of the strategies and outcomes of competitiveness management in developed Asian nations and key CIS economies. To accomplish this, the following objectives are being pursued: identify the key drivers of contemporary global competitiveness. Examine and compare the approaches to managing these drivers in selected countries. To assess the impact of implemented approaches using statistical information. To draw conclusions about the most successful approaches to managing competitiveness in the contemporary world.

Methods

The research is based on a comparative analytical study methodology, which involves analyzing secondary data. This approach allows us to compare different national models of competitiveness management and identify their strengths and weaknesses. The selection of cases: Two pairs of countries were chosen for analysis: the Innovation and Export Model (South Korea and Singapore) and the Resource-based Model (countries of the CIS region).

The Innovation and Export Model: South Korea is an example of a country that has successfully transitioned from a catching-up economy to a leading one through the development of a strong innovation system and global technology corporations, such as Samsung and Hyundai [2]. Singapore is another example of a highly competitive economy built on human capital, global talent, and world-class financial and logistics infrastructure [3]. The Resource-based Model: countries of the CIS are characterized by their reliance on natural resources, which has led to economic challenges. However, some of these countries have also made efforts to diversify their economies and attract foreign investment [4].

The Russian Federation is the largest economy in the Commonwealth of Independent States (CIS), with a strong dependence on energy exports. It is currently adapting to sanctions and seeking new growth drivers. Kazakhstan, a key economy in Central Asia, is also dependent on the export of raw materials. However, it is actively implementing strategies to diversify its economy and improve the investment climate. The analysis is based on data from reputable international organizations such as the World Bank, International Monetary Fund, World Economic Forum, Organization for Economic Cooperation and Development, as well as national statistical agencies and academic research [5], [6], [7], [8]. Four key areas were identified for comparison: innovation and technological development, human capital, and other factors that determine modern competitiveness. These include the level of spending on research and development (R&D) and the share of high-tech exports, as well as the quality of education and life expectancy. Institutional environment and business climate (positions in the Ease of Doing Business and Global Competitiveness Index rankings).

Results

A comparative analysis of the data reveals significant differences in strategies and results achieved between the two groups of countries.

Table 1. Key indicators of national competitiveness (data for 2022-2023)

Dimension	South Korea	Singapore	Russia	Kazakhstan
GDP per capita (PPP, $K)	50.1	133.1	36.4	30.8
GCI Ranking (WEF)	13	1	43 (until 2022)	55
Ease of Doing Business	5	2	28	25

R&D Expenditure (% GDP)	4.9%	1.9%	1.1%	0.1%
Human Capital Index	0.84	0.88	0.73	0.63

Sources: World Bank, WEF, OECD.

These show a stark gap between innovation-led economies (Singapore, South Korea) and resource-transitioning nations (Russia, Kazakhstan).

The data from Table 1 already shows a significant gap at the macro level. Singapore and South Korea are significantly ahead of Russia and Kazakhstan in terms of GDP per capita and the quality of human capital. The difference in the level of investment in research and development (R&D) is particularly striking: South Korea is one of the world leaders in this indicator (4.9%), while in Kazakhstan it is at a minimum level (0.1%).

Analysis of the structure of the economy and diversification

The key difference between the models lies in the structure of their economies and exports. Asian countries have built diversified economies focused on exporting high-tech products, while the CIS economies remain dependent on raw materials.

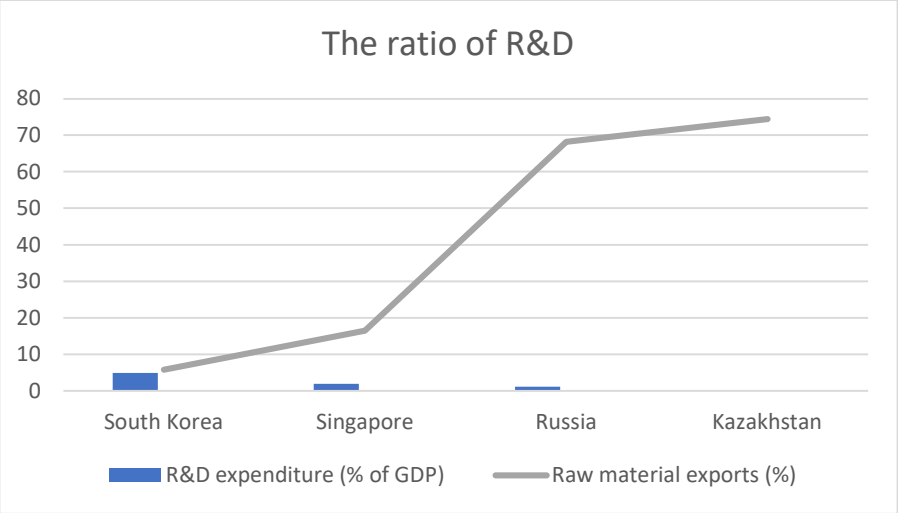
Table 2. Structure of Merchandise Exports (% of total, 2022)

Product Category	South Korea	Singapore	Russia	Kazakhstan
Fuel & Raw Materials	5.8%	16.5%	68.2%	74.5%
Machinery & Electronics	38.5%	45.2%	5.5%	1.9%
Chemicals	13.1%	12.8%	6.1%	4.8%
Metals	8.2%	3.1%	9.8%	12.5%

Source: Compiled by the author based on data from the ITC Trade Map [9].

The data from Table 2 clearly demonstrates the fundamental difference. More than two thirds of Russia and Kazakhstan's exports are raw materials, which makes their economies extremely vulnerable to fluctuations in global prices. In contrast, South Korea and Singapore are dominated by high-value-added products, which ensure stable export earnings and stimulate innovation.

Chart 1. The ratio of R&D costs and the share of raw materials in exports.



The diagram clearly illustrates the inverse relationship between countries' investment in R&D and their dependence on commodity exports. Countries with a high investment in R&D tend to have a lower dependence on commodity exports, while countries with a lower investment in

R&D are more dependent on commodity exports. This confirms the existence of two different models of competitiveness management.

Discussion

The analysis confirms that the competitiveness management strategies of developed countries in Asia and the Commonwealth of Independent States (CIS) are significantly different, which has a direct impact on their economic performance. South Korea and Singapore's success is not a coincidence. It is the result of decades of government policies aimed at accelerating human capital development through investments in education and science and creating world-class universities. They have also stimulated innovation and R&D through tax incentives for high-tech companies and support for national champions and innovation clusters. Creation of a high-quality institutional environment: protection of property rights, fight against corruption, and simplification of administrative procedures for businesses [10]. Despite some progress in the CIS countries (for example, Kazakhstan's success in the Doing Business ranking and the development of digital public services in Russia), there are still structural problems. The high dependence on the raw materials sector leads to a "resource curse" effect, which reduces incentives for diversification and makes other exports uncompetitive. It also often leads to high levels of corruption and the concentration of capital in the hands of the state or narrow elites [11].

The theoretical and practical implications of this situation are significant. From a theoretical perspective, the study supports the relevance of Michael Porter's theory on national innovation systems and competitive advantages of countries, which emphasizes the importance of dynamic factors, such as innovation and quality of demand, rather than static ones like resources [12].

Practical recommendations for CIS and Central Asian countries include: aggressive diversification: creating real incentives for the development of non-resource sectors, such as manufacturing, IT, and the agro-industrial complex. Investments in education and research: increasing funding for R&D and reforming the education system to focus on training engineers and IT professionals. Improving the business climate by further reducing administrative barriers, ensuring the rule of law and protecting investments in order to attract high-quality foreign capital for non-resource industries. This corresponds with the view that the state plays a critical entrepreneurial role in shaping and directing innovation-led growth, rather than merely fixing market failures [13]. Special attention should also be paid to how national identity and post-Soviet institutional legacies affect competitiveness policy-making [14]. Limitations of the study: this analysis is at a macro level and does not take into account significant regional differences within large countries like Russia. Additionally, the global economic situation is rapidly changing due to geopolitical factors, which can both slow down or accelerate structural reforms.

Conclusion

Managing competitiveness in a globalized world requires governments and companies to move from a reactive policy to a proactive strategy aimed at creating sustainable long-term advantages. A comparative analysis of the economic models of Asia and the CIS has clearly shown that in the 21st century, the main source of national wealth and competitiveness is not what is extracted from the earth, but what is created by the human mind. The experience of South Korea and Singapore proves that even countries without significant natural resources can achieve the highest level of prosperity through reliance on innovation and human capital. For the CIS and Central Asian countries, this means the need for a fundamental restructuring of the economic model. Without this step, the gap in competitiveness with advanced countries will only grow. That national competitiveness in a globalized context depends on systemic investment in innovation, export diversification, and institutional reforms. Countries like Kazakhstan can benefit from transitioning toward a more knowledge-based economy by leveraging comparative lessons from

advanced Asian economies. Future research should include longitudinal analysis and sector-specific case studies.

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Organizational Business Process Reengineering: Methodological Perspectives

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Annotation. In the age of global digital competition, the process of reengineering business processes (RBP) is becoming an essential component of the strategy for companies aiming to achieve significant improvements. This article delves into the methodological aspects of RBP in the context of two distinct economic models in Asia: China, a global technological leader, and Kazakhstan, a rapidly developing digital hub in Central Asia. This paper conducts a comparative analysis of RBP approaches, identifies key success factors driven by national strategies (such as China's "Made in China 2025" and Kazakhstan's "Digital Kazakhstan"), and examines the influence of specific socio-cultural and economic conditions on transformational processes. The article incorporates up-to-date statistical data on the digitalization of China's and Kazakhstan's economies, presents two tables summarizing success factors and case study outcomes, and includes a diagram illustrating a universal digital reengineering model. The concluding section delves into the distinctive hazards and practical consequences of implementing RBP approaches in various nations, providing valuable perspectives for global business and academia.

Keywords: business process reengineering, methodology, digital transformation, change management, key performance indicators (KPIs), Kazakhstan, China.

Introduction

Business process reengineering (BPR), defined as the fundamental rethinking and radical redesign of processes to achieve significant improvements in key performance indicators, is undergoing a revival in the context of the Fourth Industrial Revolution [1]. However, traditional Western BPR models require serious adaptation when applied in countries with different economic and cultural backgrounds [2]. In this regard, China and Kazakhstan are of particular interest, as they demonstrate impressive but fundamentally different approaches to technological modernization. The relevance of this study lies in the uniqueness of the trajectories of China and Kazakhstan. China, under the "Made in China 2025" strategy, is undergoing a large-scale transformation from a "global factory" into a technological superpower [3]. RBP (Robotic Process Automation) is being integrated into the ecosystems of giant corporations, supported by powerful government policies, in order to achieve this goal. Kazakhstan, on the other hand, is implementing the "Digital Kazakhstan" state program in order to diversify its economy, develop digital services, and create a regional technology hub [4]. RBP is becoming a tool for modernizing the public sector and private businesses, particularly in the financial and technology sectors [5].

The main issue with the current research on RBP (reengineering business processes) is that most studies are either general in nature or focused on Western experiences, ignoring the specific application of these methods in Asian economic models, where the role of the state is significant [6]. There is a lack of comparative studies that analyze how national policies, market structures,

and cultural factors influence the selection of approaches, success factors, and outcomes of reengineering efforts [7]. This article aims to conduct a comparative analysis of methodological aspects of reengineering business processes in organizations in China and Kazakhstan, identifying common patterns and national-specific characteristics.

To accomplish this goal, we set the following objectives: To consider the national strategic plans of China and Kazakhstan as the context for reengineering projects. Based on an analysis of relevant data, to identify and compare key success factors and risks associated with RBP projects in these two countries. To present a generalized model of digital RBP that can be applied in various contexts. Analyze practical cases that demonstrate the results of RBP in Chinese and Kazakhstani companies. To discuss the similarities, differences, and practical implications of applying RBP methodologies in the countries studied.

Methods

This study is based on a qualitative comparative analysis methodology with elements of a literature review. The information base consists of scientific publications, reports from international consulting agencies (McKinsey, PwC, and BCG), data from the World Bank, and official government portals in China and Kazakhstan covering the period from 2021 to 2025. We searched for sources in the Scopus, Web of Science, Google Scholar, and CyberLeninka databases using the following key queries: "business process reengineering in China", "digital transformation in Kazakhstan", "case study of Made in China 2025", "results of Digital Kazakhstan", "fintech in Kazakhstan", and "smart manufacturing in China". To organize the data, we applied the content analysis method, which allowed us to identify and summarize key success factors and risks specific to each country (Table 1).

The case study method was used to demonstrate the practical outcomes of the RBP. Examples from key industries in each country were chosen: high-tech manufacturing in China and the financial and technology sector in Kazakhstan. Quantitative and qualitative indicators before and after reengineering are summarized in Comparative Table 2.

A universal model of the digital RBP (Diagram 1) has been developed by combining existing theoretical approaches. It is designed to be flexible, so it can be adapted to different contexts, but it also includes specific content for each individual case.

The main limitation of this study is the language barrier, which prevents us from accessing the full range of Chinese primary sources. Additionally, companies' trade secrecy often restricts public access to detailed quantitative data on RBP projects. However, the use of reports from reputable international organizations and the analysis of publicly available data allow us to ensure the validity and reliability of our conclusions.

Results

National strategies and statistics in the context of RBP (robotic business process) in China and Kazakhstan are largely influenced by government strategies. In China, the "Made in China 2025" initiative is driving industrial transformation through the introduction of cyber-physical systems, big data, and the Industrial Internet [8]. As of 2023, China has become the global leader in the number of industrial robots and the cost of digital transformation exceeds $300 billion [9]. For 2024, the country plans to invest more than 40% of its research and development (R&D) budget in fundamental technologies underlying the digital economy [10].

In Kazakhstan, the Digital Kazakhstan program drives RBP in public services and finance. The country has reached an internet penetration rate of 93% by 2024 and e-commerce grew by more than 30% in 2023 [11]. Success of national financial technology companies demonstrates the efficacy of building digital ecosystems from the ground up.

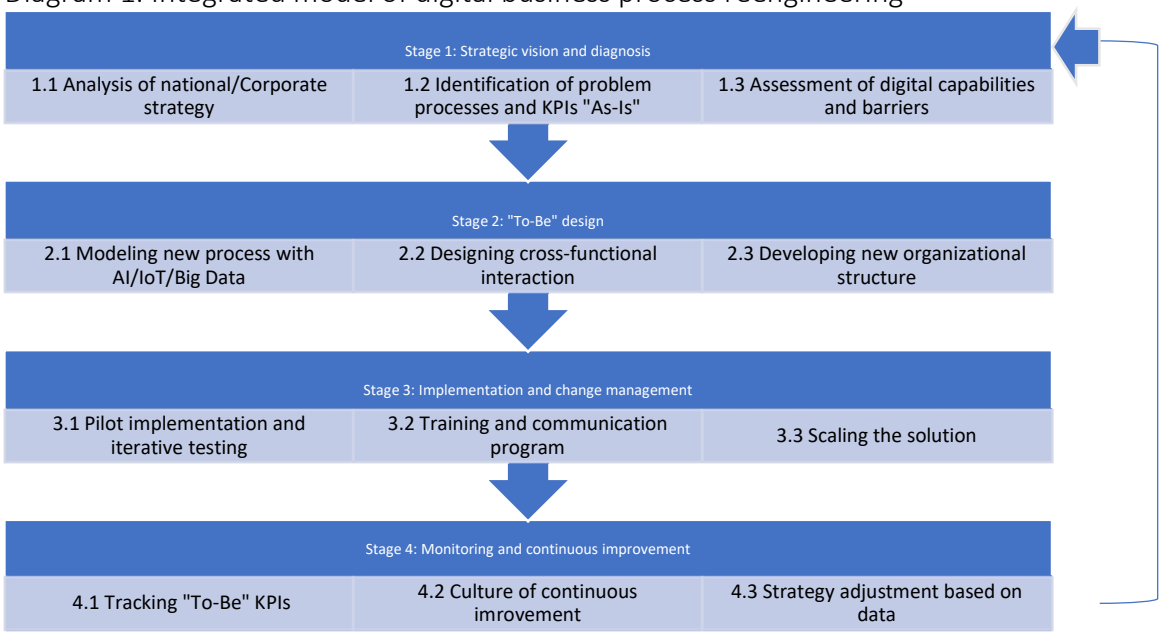
Table 1. Key Success Factors and Risks of BPR Projects (Comparative Analysis)

Category	China	Kazakhstan
Success Factors	1. Strong government support and subsidies under the "Made in China 2025" strategy. 2. Large domestic market enabling rapid testing and scaling of innovations. 3. High competition driving companies to pursue radical efficiency improvements. 4. Well-developed tech ecosystem (Alibaba Cloud, Tencent, Huawei).	1. Clear national programs ("Digital Kazakhstan") and political will for change. 2. Success of national champions (e.g., Kaspi.kz) as role models and talent sources. 3. High adaptability of the population to digital services (especially in finance). 4. Opportunity to leapfrog outdated technologies.
Failures	1. Neglect of the "human factor" in pursuit of technology; strong resistance to change. 2. Overemphasis on speed at the expense of quality and sustainability. 3. Information security and data leakage risks in highly centralized systems. 4. Geopolitical tensions and trade restrictions affecting tech access.	1. Digital divide between major cities and rural areas. 2. Shortage of highly qualified IT professionals and reliance on external contractors. 3. Risks of market monopolization by a few large digital ecosystems. 4. Bureaucratic obstacles in implementing government initiatives locally.
Source: Compiled by the author based on analysis of reports by McKinsey (2023), PwC (2024), and others.		

A universal model and practical cases

Despite the differences in context, the process of digital RBP itself can be represented as a universal model that includes four key stages (Diagram 1).

Diagram 1. Integrated model of digital business process reengineering



Source: compiled by the author

The application of this model in practice leads to impressive results, which is confirmed by cases from China and Kazakhstan (Table 2).

Table 2. Comparative Analysis of BPR Outcomes (Case Study Examples)

Country / Company	'AS-IS' Process (Problem)	Applied BPR Methods / Technologies	Key Outcomes ('TO-BE' Process)
China *(Home appliance manufacturer Haier)*	Traditional rigid hierarchical structure, slow response to market demands, and long product development cycle.	Radical organizational redesign. Elimination of middle management. Creation of over 4,000 self-managed micro-enterprises (RenDanHeYi platform).	1. New product development cycle reduced from several months to weeks. 2. Direct team interaction with end users. 3. Revenue and market capitalization tripled in 10 years.
Kazakhstan *(Fintech company Kaspi.kz)*	Fragmented and user-unfriendly banking, payment, and e-commerce services. Long, in-person dependent processes.	Creation of a unified digital ecosystem (Super App) from scratch. Integration of payments, marketplace, government services, loans, and cards. Complete customer journey redesign.	1. Over 13 million monthly active users (as of 2023). 2. Most operations (payments, transfers) completed in seconds. 3. IPO on LSE with high valuation, becoming one of Kazakhstan's most valuable public companies.
Source: Compiled by the author based on public company reports and analytical articles (2022–2024).			

Discussion

The findings reveal significant differences in the methodological approaches of RBP (Rapid Business Process) in China and Kazakhstan, despite the general principles that underlie the methodology.

In China, RBP tends to be more technocentric and focus on scale. The driving force behind this is fierce competition and the government's desire for technological leadership. For example, companies like Haier are willing to undergo radical organizational transformations, breaking down traditional hierarchical structures in favor of more flexible, market-driven teams. The approach here often follows the "technology first, process second" principle, where the introduction of advanced technologies (such as AI and IoT) necessitates a fundamental shift in business operations. However, this approach can lead to dehumanization and a disregard for organizational culture, potentially causing high staff turnover and internal tension.

In Kazakhstan, RBP (Relationship-Based Pricing) is client-centric and ecosystem-based. The main driving force is not competition, but the desire of the government and advanced companies to create new markets and improve the quality of services for citizens [12]. An example of this is Kaspi.kz, which illustrates that a successful RBP relies not just on automation, but on creating a seamless customer experience by integrating various services [13].

The methodology of RBP follows the principle of "customer needs first, then process and technology," which allows for high customer loyalty and rapid acceptance of innovations. However, there are risks associated with this approach, such as the possibility of monopolization and the creation of "walled gardens" that restrict competition in the long term. Comparing the two approaches to RBP, we can see that the Chinese model focuses more on the operational efficiency of internal processes, such as production and logistics, while the Kazakh model emphasizes creating value through external, customer-oriented processes. The integrated model presented in Diagram 1 demonstrates its versatility, but the content of each stage varies. For example, the "Strategic Vision" stage emphasizes the goals of "Made in China 2025" in China and "Digital Kazakhstan" in Kazakhstan. The "Design" phase in China focuses on cyber-physical systems, while in Kazakhstan, it emphasizes mobile platforms and super apps. This indicates that there is no one "best" approach to RBP. Instead, the selection and adaptation of a methodology must be tailored to the specific national, sectoral, and organizational contexts.

Conclusion

A comparative analysis of the methodological aspects of business process reengineering (BPR) in China and Kazakhstan has led to several key conclusions. National strategies, such as "Made in China 2025" and "Digital Kazakhstan", are not merely background information, but rather fundamental factors that determine the goals, scope, and tools of BPR. In China, BPR is driven by the country's ambition to lead in technology and compete with other countries, while in Kazakhstan, it is driven by the need to diversify its economy and modernize its services. Different models of BPR have been identified in these two countries. In China, there is a focus on a technocentric approach that aims to radically improve production and logistics efficiency, often through the complete reorganization of structures. In contrast, Kazakhstan emphasizes a customer-centric approach that focuses on creating integrated digital ecosystems and redefining customer experiences. The key success factors and risks are specific to each country. Government support and market size are crucial for China, while the risks of ignoring the human element are high. In Kazakhstan, success depends on successful national projects and adaptability of the population. However, there are risks such as a digital divide and lack of personnel.

RBP can be a catalyst for significant results in both countries. Despite differences in approaches, successful reengineering in China and Kazakhstan can lead to a dramatic increase in key indicators, such as cycle acceleration, multiple growth in user base, and market capitalization. The practical significance of this study is that it offers managers and consultants working in Asian

markets a structured understanding of how to apply the RBP methodology in their local contexts. The theoretical contribution lies in its contribution to comparative management and reengineering theory by demonstrating the influence of national context on management concepts. Future research could focus on conducting a more in-depth quantitative analysis of the impact of RBP on company performance in these countries, as well as exploring RBP processes in other industries.

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Impact asymétrique de la crise financière de 2008 selon le niveau de richesse et d'intégration économique des pays

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Résumé : Cet article propose une analyse approfondie des crises financières internationales, en retraçant leur évolution historique, identifiant leurs formes typiques et mobilisant les principales théories pour en expliquer les causes et mécanismes. L'attention est centrée sur la crise financière internationale de 2008, considérée comme un choc systémique majeur. L'étude de cas empirique repose sur une base de données regroupant les taux de croissance de 87 pays à revenus élevés et 25 pays à faibles revenus dont Madagascar.
Deux analyses statistiques sont menées : (1) une ANOVA à mesures répétées met en évidence une chute très significative du taux de croissance entre 2007 (avant crise) et 2009 (après crise) dans les deux groupes de pays. C'est l'effet-choc confirmant le caractère fortement déstabilisateur de cette crise financière majeure affectant l'ensemble des économies mondiales. Et, (2) une analyse statistique complémentaire pour évaluer le temps de reprise entre 2007 (avant) et mi-2013 (après), pour valider le propos de Reinhart & Rogoff (2014). Nous avons vu que 7 ans après la crise de 2008, seuls les pays pauvres semblent avoir retrouvé leur niveau de croissance d'avant-crise, car les pays riches – aux économies très interconnectées – continuent de subir une baisse significative de leur croissance ; ce qui infirme leur théorie.
Ces résultats valident l'hypothèse d'un impact asymétrique de la crise de 2008 selon le niveau de richesse et d'interconnexion économique des pays. L'article conclut par les leçons prises en réponses à la crise, entre autres, l'indépendance de la politique monétaire, le déploiement des outils non conventionnels, la réforme structurelle du secteur bancaire ; que sont des mesures prises par les grandes Banques centrales nationales comme la Fed, la BCE... En outre, les organismes internationaux, les régulateurs supranationaux et les gouvernements nationaux ont promu et mis en œuvre les réformes réglementaires, macroprudentielles, de transparence et de coopération.
Mots-clés : crise financière ; crise financière internationale de 2008, croissance mondiale, effet choc, reprise après crise, réponses institutionnelles.

1. Introduction

La crise financière est un phénomène ancien et récurrent dans l'histoire économique mondiale, qui, dans un contexte d'interconnexion croissante des économies, représente une menace permanente. Parmi les crises majeures, celle de 2008 a marqué un choc systémique mondial d'une ampleur inédite depuis la Grande Dépression de 1929. Cette crise a mis en lumière les vulnérabilités des économies mondiales, notamment en raison de leur interdépendance financière accrue.

Cette étude se concentre sur la crise financière internationale de 2008 afin de répondre à la problématique suivante : ***cette crise a-t-elle affecté de manière significative l'économie mondiale ?***

Cet impact a-t-il différé selon le niveau de revenu des pays ? Les pays à revenu élevé ont-ils mis plus de temps à retrouver leur niveau de PIB réel d'avant-crise comparativement aux pays à faible revenu ? Le but c'est de pourvoir valider empiriquement la théorie de Reinhart et Rogoff (2014) qui suggère que les pays à revenus élevés mettent plus de temps à se remettre d'une crise majeure comparativement aux pays à faibles revenus.

Les objectifs principaux de notre recherche sont donc (*i*) de comparer l'évolution du taux de croissance des pays à revenus élevés (87 pays) et à faibles revenus (25 pays) avant et après la crise, (*ii*) de mesurer l'effet de l'interaction entre le temps (avant/après crise) et le niveau de revenu (riches/pauvres) sur le taux de croissance, en identifiant le temps moyen de reprise après crise pour chaque groupe de pays. Pour cela, une ANOVA à mesures répétées est utilisée afin de tester la significativité statistique de ces différences, aidée par le logiciel Jamovi 2.6.26.

Quatre hypothèses fondamentales guident notre recherche : (H1) la crise financière internationale de 2008 a provoqué une baisse significative du taux de croissance du PIB mondial ; (H2) cette baisse est plus prononcée dans les pays à revenus élevés que dans les pays à faibles revenus ; (H3) les pays riches ont mis plus de temps à retrouver leur niveau de croissance d'avant-crise que les pays pauvres et (H4) il existe une interaction significative entre le temps et le niveau de revenu dans l'évolution du PIB.

Dans un premier temps, cette étude retrace brièvement l'historique des crises financières internationales. Ensuite, elle passe en revue les théories majeures expliquant la nature et les effets des crises systémiques. Enfin, elle présente un cas empirique spécifique qui vise à confirmer ou infirmer les résultats théoriques de Reinhart et Rogoff (2014) sur la durée de la reprise selon le niveau de richesse des pays.

2. Chronologie des crises financières mondiales : de l'Empire romain à nos jours

Encadré 1 : Grandes crises financières dans le monde depuis l'Empire romain

235-284 : crise monétaire dans l'Empire romain avec dévaluation, inflation, perte de pouvoir d'achat et application de la loi de Gresham : « *la mauvaise monnaie chasse la bonne* ».
1634-1637 : spéculation sur les tulipes en Hollande, menant à un effondrement brutal des prix.
1720 : éclatement de bulles spéculatives en France (Compagnie du Mississippi) et au Royaume-Uni (*South Sea Company*).
1797 : panique bancaire au Royaume-Uni, forçant la Banque d'Angleterre à suspendre la convertibilité en or.
1847 : crise boursière en France et au Royaume-Uni après une bulle spéculative sur les chemins de fer.
1873 : krach à Vienne lié à l'immobilier ; début d'une longue dépression économique en Europe.
1882 : faillite de l'Union Générale en France, causant une crise bancaire nationale.
1907 : panique bancaire aux États-Unis, révélant les faiblesses du système financier.
1929 : krach boursier à Wall Street suivi d'une dépression mondiale favorisant les régimes autoritaires.
1966 : crise du crédit aux États-Unis suite à la hausse des taux de la Fed.
1982 : crise bancaire mondiale après que le Mexique déclare un moratoire sur sa dette.
1987 : chute record de Wall Street le 19 octobre, surnommée « *lundi noir* ».
1994 : crise financière au Mexique suite à la dévaluation du peso.
1997 : crise asiatique déclenchée par l'effondrement du baht thaïlandais.
2000 : explosion de la bulle Internet alimentée par la spéculation technologique.
2008 : crise des *subprimes* aux États-Unis, transformée en crise mondiale par la titrisation.

Source : Analyses auteurs, 2025.

3. Typologie des crises financières

3.1. Crises bancaires

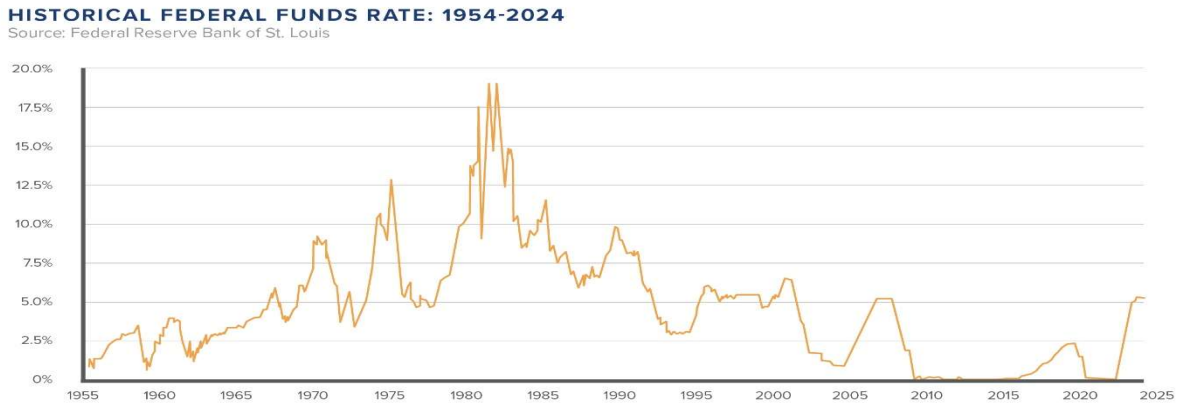
Les crises bancaires sont parmi les plus coûteuses socialement. Elles surviennent lorsqu'une ou plusieurs banques font face à des problèmes graves de liquidité (incapacité à faire face à des retraits soudains) ou de solvabilité (valeur des actifs inférieure aux dettes). La défaillance d'une

banque peut entraîner des retraits massifs (*bank run*) ou l'incapacité de refinancement, souvent liés à des pertes liées à des prêts non remboursés ou à la dépréciation des actifs.

Ces deux problèmes sont fréquemment liés et, avec la mondialisation bancaire des années 2000, les crises bancaires sont devenues contagieuses. Un exemple marquant est la crise de 2008, dite des *subprimes*. Pour relancer l'économie après 2001, les banques américaines, soutenues politiquement, ont accordé des crédits immobiliers à taux variable à des ménages peu solvables. Cela a provoqué une bulle immobilière. Lorsque la Fed a relevé ses taux dès 2005, les mensualités ont explosé, menant à des défauts massifs de paiement, des saisies, puis une chute des prix. Ce mécanisme a provoqué des pertes colossales pour les banques, dont la faillite de Lehman Brothers (15 septembre 2008), et un effondrement global par effet de contagion.

Les banques centrales (Fed, BCE) ont alors mené des politiques d' « assouplissement quantitatif », tandis que les États ont engagé des plans de relance. Malgré ces efforts, les effets persistent plus de dix ans plus tard. En mars 2023, la faillite de plusieurs banques américaines et européennes (dont Crédit Suisse et Deutsche Bank) a ravivé les craintes. Depuis l'invasion de l'Ukraine par la Russie en 2022, l'inflation mondiale a explosé, poussant les banques centrales à relever leurs taux, ravivant ainsi les risques de crise financière mondiale. Certains spécialistes restent optimistes, affirmant qu'un mécanisme de contagion majeur n'existe pas. Le graphique suivant montre les tendances des taux directeurs américains de 1955 à 2025 :

Graphique 1 : Evolution historique des taux directeurs de la Fed de 1954 à 2024



Source : *Board of Governors of the Federal Reserve System (US), last updated 2025-01-02. In* https://fred.stlouisfed.org/data/RIFSPFFNA

3.2. Crises monétaires

Beaucoup d'analystes confondent crises monétaires et crises de change, alors qu'une crise monétaire peut déclencher une crise de change, voire même une crise bancaire. Une crise monétaire résulte d'une chute de la valeur d'une monnaie nationale ou d'un ensemble de pays face à d'autres devises, due à une perte de confiance des investisseurs, à une hausse excessive de la masse monétaire ou à une hyperinflation. La conséquence typique est une variation brutale du taux de change, accompagnée de fuite des capitaux ou de défaut souverain.

Léon Walras (1898), dans ses *Cours d'économie appliquée*, définit la crise monétaire comme une réduction rapide de la masse monétaire. Cependant, cette définition a suscité des critiques : certains soulignent que la crise peut survenir lors d'une augmentation brutale de la création monétaire. Ainsi, le terme crise monétaire est polysémique, car il recouvre aussi bien la déflation que l'hyperinflation et la fuite de capitaux.

Les crises monétaires étaient fréquentes au début du XX^{e} siècle, particulièrement dans l'entre-deux-guerres, ce qui a conduit à la signature des accords Bretton Woods pour réguler le Système

monétaire international (SMI). Dans les années 1990, les pays en développement ont été fortement touchés par des crises monétaires et de change. C'est pourquoi la règle Greenspan-Guidotti (1999) a été adoptée : les réserves de change doivent être égales à la dette extérieure à court terme, pour se prémunir contre des fuites massives de capitaux. Cette règle a été suivie par de nombreux pays émergents, conduisant à des réserves excessives – parfois couvrant jusqu'à 200-260 % de la dette extérieure, comme au Mexique… avec des effets secondaires comme l'inflation ou l'excès de liquidité mondiale.

L'exemple le plus ancien connu de crise monétaire remonte à l'Empire romain (235-284 après J.-C.), où la « mauvaise monnaie » (dévalorisée à 50 % d'argent fin) chassa la « bonne monnaie » selon la loi de Gresham, provoquant une chute du pouvoir d'achat (perte salariale de 17-31 % par rapport à l'or), une inflation forte, un refus du paiement des impôts et une migration massive. Ce processus crise a contribué à la chute de l'Empire romain, faute de réserves financières suffisantes.

Aujourd'hui, depuis le début de la guerre en Ukraine en 2022 et les faillites bancaires de mars 2023, de nombreux analystes redoutent une « crise monétaire généralisée » – Simone Walper (2023) parlant du « danger suprême[1] ». Cette crainte repose sur le relèvement des taux d'intérêt par la Fed et la BCE pour lutter contre une inflation qu'ils ont créé eux-mêmes après les crises de 2001 et 2008. Cette hausse des taux, couplée à un surendettement massif (par exemple les États-Unis à 135 % du PIB), représente un cocktail explosif.

3.3. Crises boursières

Une crise boursière, aussi appelée krach, désigne une chute brutale et massive des cours d'une ou plusieurs catégories d'actifs financiers sur une ou plusieurs places boursières. Ce phénomène entraîne une panique sur les marchés : les investisseurs vendent massivement, provoquant une chute des prix sans acheteurs. Cette crise affecte plusieurs entreprises d'un pays, puis se propage par contagion à l'échelle mondiale. Les indices boursiers représentatifs, comme le CAC 40 à Paris ou le Dow Jones à New York, enregistrent alors une forte baisse rapide.

La cause principale est la formation préalable d'une bulle financière, née d'un emballement spéculatif amplifié par la facilité d'accès au crédit bancaire et monétaire. Lorsque la majorité des spéculateurs réalise que les prix ont atteint un sommet, la panique s'installe, déclenchant une course à la vente. Charles Kindleberger (1978) souligne que « la panique se renforce d'elle-même », jusqu'à ce que (*i*) les prix chutent assez pour attirer des acheteurs, (*ii*) les transactions soient suspendues ou (*iii*) qu'un prêteur en dernier ressort, souvent la Banque centrale, intervienne pour rassurer les marchés et fournir des liquidités.

Le krach le plus célèbre est celui de 1929 à New York, marquant le début de la Grande Dépression. En deux jours (28 et 29 octobre, « lundi et mardi noirs »), l'indice Dow Jones perdait 23,05% de sa valeur, et près de 90% sur 30 mois (octobre 1929 – juillet 1932). Ce krach résultait d'une bulle spéculative alimentée par le système d'achat à crédit d'actions instauré en 1926 (*call loans*). Selon Kindleberger, les causes immédiates furent une fuite massive de capitaux à New York, liée à des facteurs financiers (diminution des prêts des courtiers) et politiques (hausse des taux d'intérêt aux États-Unis et en Angleterre).

Le krach de 1929 a provoqué un effondrement mondial des marchés, une crise bancaire et économique, avec un chômage explosif (passant de 1,5 million à 15 millions en 1933) touchant particulièrement les classes moyennes et ouvrières. Les indices boursiers ne retrouveront leurs niveaux d'avant-crise qu'après 25 ans.

Après le krach de 1929, d'autres crises boursières majeures ont marqué l'histoire économique mondiale. Par exemple, le krach de 1987, connu sous le nom de « lundi noir », a vu l'indice Dow

[1] Simone Walper, 12 Avril 2023, « Comment éviter que l'Etat ne vole notre épargne ? ». *In* https://contribuablesassocies.org/2023/04/12/simone-wapler-comment-eviter-que-l-etat-ne-vole-notre-epargne-video/

Jones chuter de près de 22% en une seule journée, provoquant une onde de choc sur les marchés mondiaux. Plus récemment, la crise financière de 2008, déclenchée par l'effondrement du marché immobilier américain et la faillite de grandes institutions financières, a provoqué un krach mondial.

4. Théories économiques sur les crises financières

4.1. Approches exogènes *vs* approches endogènes

Les crises financières peuvent avoir des origines exogènes ou endogènes, selon différentes écoles de pensées. Les approches exogènes, issues des modèles keynésiens et néoclassiques, considèrent que les crises résultent de chocs extérieurs au système économique. Après la crise de 1929, les keynésiens ont développé des modèles visant à amortir les fluctuations cycliques par des politiques de stabilisation (Joseph Schumpeter, 1911). Les néoclassiques perçoivent les crises comme des perturbations économiques, exclues de l'analyse en situation d'équilibre.

En revanche, les approches endogènes, notamment marxistes et celles de Hyman Minsky (1996), intègrent les crises au cœur du fonctionnement du capitalisme. Karl Marx, dans *Le Capital* (1867), voit les crises comme inévitables et structurelles. Minsky, dans *Stabiliser une économie instable* (2016), décrit un cycle en cinq phases : boom spéculatif, recours accru au crédit, détresse financière, effondrement (paroxysme de la crise), puis retour à la normale.

4.2. Approche monétariste

Pour les Monétaristes, les crises financières sont souvent déclenchées par des paniques bancaires, liées à une perte de confiance dans la capacité des banques à restituer les dépôts. Cette panique provoque une ruée bancaire, une diminution de la masse monétaire, et peut aggraver une récession. Ce phénomène est amplifié si la Banque centrale n'intervient pas rapidement comme prêteur en dernier ressort pour stabiliser la masse monétaire. Même les banques saines deviennent alors vulnérables, leurs actifs perdant de la valeur. Friedman et Schwartz (1963) ont montré qu'entre 1867 et 1960, quatre des six grandes contractions monétaires aux États-Unis coïncidaient avec des perturbations majeures du système bancaire, soulignant ainsi le rôle central de la stabilité monétaire dans la prévention des crises.

4.3. Aléa moral

La crise financière ne résulte pas uniquement de déséquilibres macroéconomiques, mais surtout de comportements d'aléa moral et de défaillances de régulation bancaire et financière. Adam Smith soulignait déjà au XVII^{e} siècle que la recherche du profit individuel sans souci des conséquences collectives menace le capitalisme. Dans les marchés financiers, les banques prennent des risques excessifs, croyant être protégées par les banques centrales.

Ce phénomène de « privatisation des profits et nationalisation des pertes » est amplifié par le rôle systémique de certains établissements dits « *too big to fail* ». En 2008, Ben Bernanke a noté que les aides aux banques après la crise de 2008 ont renforcé cet aléa moral. La crise a été aggravée par une régulation insuffisante. Toute analyse doit intégrer les failles réglementaires préexistantes. Christian Noyer (2009) recommande une surveillance macroprudentielle des acteurs systémiques pour renforcer la résilience du système financier post-crise.

4.4. Endettement et fragilité financière

Cette approche considère les crises financières comme des phénomènes structurels du cycle économique, intervenant après une phase d'excès. Le cycle se divise en deux temps : (1) dans la phase ascendante, Charles Kindleberger (1978) identifie un « déplacement » exogène qui crée des opportunités d'investissement, entraînant une spéculation croissante, un recours accru à l'endettement et une expansion de la masse monétaire. Irving Fisher (1930) souligne que l'augmentation de la vitesse de circulation de la monnaie alimente cette dynamique. La hausse des prix réduit la valeur réelle des dettes, incitant à de nouveaux emprunts, jusqu'au surendettement.

Une hausse des taux d'intérêt déclenche alors des défauts de paiement, des ventes de détresse, une baisse des prix, des retraits bancaires massifs et une crise si la Banque centrale n'intervient pas. (2) Dans la phase descendante, Fisher (1933) attribue la spirale récessive à la combinaison surendettement plus déflation. Hyman Minsky (1982) parle de « fragilité financière » reposant sur des financements Ponzi, une baisse de liquidité et un endettement spéculatif menant à la crise.

4.5. Anticipations rationnelles

Plusieurs auteurs ont développé des modèles de crises financières intégrant les anticipations rationnelles, en se concentrant sur deux éléments principaux : les manies et les ruées bancaires. Les manies sont perçues comme des bulles spéculatives rationnelles, selon Blanchard & Watson (1982). Ces bulles peuvent durer ou éclater, avec une probabilité associée. Si elles persistent, les actifs doivent offrir un rendement supérieur au taux d'intérêt sans risque pour compenser le risque de krach. Toutefois, plus le temps passe, plus la probabilité de l'éclatement augmente, ce qui pousse les prix à croître de manière exponentielle pour intégrer ce risque.

Les ruées bancaires, quant à elles, sont considérées comme des attaques spéculatives sur un système de prix fixe. Flood & Garber (1981) expliquent qu'une banque peut maintenir un prix fixe sur un bien, mais si les agents anticipent que ce prix n'est pas tenable à long terme, ils réduisent leurs dépôts ou réserves, ce qui fragilise la structure. Lorsque la valeur nette de l'institution devient nulle, une ruée bancaire survient, causant la faillite, même si les déposants sont remboursés.

4.6. Incertitude et comportement mimétique

Sur les marchés financiers, l'incertitude désigne le manque de certitude sur la valeur future des actifs, poussant les agents à prendre des décisions rationnelles ou irrationnelles (Knight, 1921 ; Meltzer, 1982). Ce contexte crée des opportunités de gain, mais aussi des risques de crise financière si les décisions sont erronées. Lorsque l'information est incomplète ou irrégulière, notamment dans des environnements innovants ou non régulés, les agents peuvent mal interpréter les innovations financières, générant ainsi plus d'incertitude.

Des fois, les agents financiers imitent les leaders du marché sans analyse des fondamentaux. Ce phénomène, parfois amplifié par des algorithmes d'achat/vente automatisés, explique de nombreuses bulles spéculatives et krachs boursiers. Il est à la fois irrationnel et rationnel (profiter de l'information supposée mieux maîtrisée par autrui). Devenow & Welch (1996), ainsi que Bikhchandani & Sharma (2000) ont démontré que le mimétisme est courant sur les marchés développés et encore plus visible sur les marchés émergents où l'accès à l'information est plus limité et coûteux.

4.7. Rationnement de crédit

Selon Guttentag & Herring (1984a), les crises financières se manifestent par un rationnement brutal du crédit. Celui-ci peut prendre plusieurs formes : un rationnement par les prix via des primes de risque plus élevées, un rationnement par les quantités (Stiglitz & Weiss, 1981) lorsque la demande de crédit dépasse l'offre au taux optimal ou encore des limites absolues d'emprunt causées par une asymétrie d'information entre prêteur et emprunteur. Ce déséquilibre est aggravé par un manque de contrôle de l'emprunteur.

Ces auteurs recommandent alors une surveillance renforcée des banques, notamment par un contrôle des ratios de capital et l'usage de mécanismes complémentaires, afin d'éviter la « myopie au désastre » (la sous-estimation des risques systémiques). Ils soulignent que la responsabilité d'une crise incomberait autant aux autorités de régulation qu'aux banques, qui doivent adapter leurs stratégies pour éviter un court-termisme nuisible à la stabilité financière.

4.8. Phénomène de bulles financières

Une bulle financière désigne une hausse excessive et autonome du prix d'un actif financier, largement irrationnelle, alimentée par des anticipations de hausse future et le mimétisme des investisseurs. Deux facteurs clés peuvent le déclencher : l'expansion des crédits à bas taux et une confiance généralisée dans la solidité des fondamentaux économiques.

Cette hausse autoentretenue repose sur une sous-estimation des risques et une surestimation des gains attendus, ce qui peut déboucher sur une crise financière en cas d'éclatement. Toutefois, toutes les bulles ne provoquent pas forcément de crise systémique. Le cycle d'une bulle se compose de quatre phases : (1) la gestation (confiance économique et optimisme modéré provoquent une première hausse des prix), (2) la naissance (renforcement des anticipations haussières), (3) l'euphorie (gonflement de la bulle suite à l'endettement et aux comportements moutonniers) et (4) l'éclatement (déclenchement d'un retournement des anticipations et effondrement brutal des prix des suites d'un événement), pouvant engendrer une crise financière.

5. Causes et conséquences des crises financières

5.1. Causes des crises financières

5.1.1. Causes communes des crises financières

a. Déséquilibres des fondamentaux macroéconomiques

Durant les années 1980, notamment après la crise mexicaine de 1982, les chercheurs ont exploré les vulnérabilités macroéconomiques à l'origine des crises : déficits publics, déficits extérieurs et endettement privé. Dans les années 1990, l'attention s'est portée sur le phénomène de contagion entre économies, résultant des anticipations des investisseurs et des réponses des autorités monétaires, amplifiant ainsi les crises au niveau global.

b. Modifications de l'environnement institutionnel

Les trois dernières décennies ont été marquées par la déréglementation, la globalisation et les innovations financières radicales. La déréglementation a effacé les frontières traditionnelles entre banques commerciales, banques d'investissement et assurances, poussant les acteurs à prendre plus de risques pour maximiser leurs marges. La globalisation a permis l'entrée massive des capitaux dans les économies émergentes, provoquant des phénomènes d'accélérateur financier et exposant ces pays à des crises jumelles (banque et change) en cas d'ouverture mal encadrée des comptes de capitaux. De nouveaux instruments financiers complexes sont nés diversifiant et haussant ainsi les risques, comme l'a illustré la crise des *subprimes* de 2008.

c. Fonctionnement intrinsèque du système financier

Les crises émergent aussi du fonctionnement même des marchés financiers, notamment durant les phases d'expansion où la prise de risque devient procyclique. Ce phénomène découle souvent d'une myopie des acteurs privilégiant les gains à court terme, alimentant ainsi des bulles spéculatives. De plus, la dynamique de l'accélération financière, caractérisée par une course au crédit entre établissements, peut engendrer un risque systémique lors des retournements, perturbant la circulation des paiements. La faillite des entreprises financières et non financières provoque alors récession et chômage, exacerbées par l'interconnexion croissante des marchés.

5.1.2. Causes des crises financières dues aux interconnexions

a. Contagions horizontales (interconnexions entre économies)

Les contagions horizontales résultent d'une détérioration commune des fondamentaux économiques, provoquant des effets régionaux. Deux phénomènes sont essentiels :

- Phénomènes de mousson (*monsoonal contagion*) : une même série de chocs affecte simultanément plusieurs pays. Par exemple, la crise mexicaine de 1982, liée à la hausse des taux

d'intérêt américains, a touché en même temps plusieurs économies d'Amérique Latine.
- Effets de débordements (*spill-over effects*) : les crises se propagent entre économies liées par le commerce ou la finance. Par exemple, au début des années 1990, les attaques spéculatives contre la Livre ont déstabilisé l'ensemble du Système monétaire européen (SME).

b. Contagions verticales (interconnexions entre marchés)

Trois types de contagions verticales sont distingués :
- Contagion pure : liée aux sentiments des opérateurs et à l'asymétrie d'information, provoquant des crises financières.
- Effet de contagion (*shift-contagion*) : causé par la panique et le stress, amplifiant la diffusion des crises. Par exemple, la faillite de Lehman Brothers en 2008 a provoqué une sur-réaction globale des marchés. La contagion se mesure souvent par un accroissement du coefficient de corrélation entre marchés durant la crise.
- Crises de change de troisième génération : ces modèles expliquent les crises jumelles, les bulles spéculatives, l'illiquidité bancaire et une double méfiance vis-à-vis du système de change et des liquidités, comme lors de la crise asiatique de 1997-1998.

5.1.3. Autres causes des crises financières

a. Mondialisation financière et instabilité globale

Lors d'une table ronde en 1987 animée par Christian de Boissieu et Yves Ullmo, plusieurs experts – Michel Aglietta, Michel Cicurel, Bertrand Jacquillat, Gérard Maarek et Jean Peyrelevade – ont souligné que « *la mondialisation des activités financières depuis les années 1980 avait accru les déséquilibres macroéconomiques mondiaux* ». Selon eux, cette globalisation, en facilitant la circulation internationale des capitaux, favorise des phénomènes de contagion planétaire. Ainsi, un choc exogène sur une place financière peut rapidement affecter l'ensemble des marchés mondiaux. Cette dynamique a rendu l'économie mondiale de plus en plus instable, exposée à des chocs financiers fréquents et plus sévères.

b. Les dix causes potentielles de la prochaine crise selon Deutsche Bank (2017)

La Deutsche Bank, dans un rapport de 2017, considère qu'il serait illusoire de croire que les crises financières cessent d'être un événement régulier depuis les années 1970. Elle identifie dix causes potentielles pour la prochaine crise mondiale : (1) le politiques monétaires des grandes Banques centrales, (2) la montée imprévisible des populismes, (3) les limites des marges de manœuvre des États, (4) la crise en Italie, (5) le Brexit, (6) les risques en Chine, (7) le surendettement du Japon, (8) la manque de liquidité sur les marchés, (9) les déséquilibres croissants des balances courantes, (10) les niveaux records du prix des actifs mondiaux.

Or, d'autres causes existent encore comme les risques cyber et vulnérabilités technologiques, les chocs géopolitiques majeurs (conflits, guerres commerciales), les inégalités sociales croissantes fragilisant la demande et la stabilité économique, la réglementation financière insuffisante ou l'inadéquate malgré la dérégulation, et les effets climatiques liés à la transition écologique impactant l'économie mondiale.

5.2. Conséquences des crises financières

5.1.1. Conséquences économiques et monétaires des crises financières

5.1.1.1. Conséquences économiques

a. Un chômage en hausse

La chute de la croissance, souvent négative lors d'une crise, entraîne un ralentissement des activités. En réponse à la baisse de la demande, les entreprises réduisent leurs effectifs, ce qui provoque une hausse brutale du chômage.

b. Un accès aux crédits plus difficile

Les banques, confrontées à une crise de confiance et à des pertes financières, resserrent leurs conditions de crédit. L'accès au financement devient difficile pour les ménages et les entreprises, accentuant le ralentissement économique. Les établissements bancaires voient leur capacité à prêter diminuer, notamment en raison de la perte de capital et de la dépréciation de leurs actifs. Comme l'a illustré Alain Madelin sur BFMTV en 2008 : *« pour 1 euro perdu, une banque a réduit ses prêts de 12 euros »* (Adrien de Tricornot, 2008).

c. Une accalmie sur les prix

Une crise financière peut provoquer une baisse des prix, soulageant les consommateurs. Toutefois, la dépréciation de la monnaie nationale, fréquente en période de crise, favorise les exportations tout en augmentant le coût des importations.

d. Une suspension des investissements

L'incertitude économique et les tensions financières rendent les entreprises plus prudentes. Ainsi, les projets d'investissement sont ralentis ou suspendus, y compris les opérations de fusion-acquisition.

e. Une marge de manœuvre budgétaire limitée

Selon Romer & Romer (2019), les États faiblement endettés peuvent adopter des politiques budgétaires expansionnistes en temps de crise, atténuant les impacts négatifs. En revanche, les pays fortement endettés se voient contraints à des mesures restrictives, ce qui aggrave les effets économiques de la crise.

5.1.1.2. Conséquences monétaires

Les crises financières ont aussi des impacts majeurs sur la politique monétaire. Selon M. Friedman (2016), elles provoquent l'effondrement des institutions financières, la destruction de richesses, l'interruption des flux de crédit et une perte de confiance généralisée. Pour y répondre, la Fed et la BCE ont adopté, après 2008, des mesures exceptionnelles. D'abord, elles ont abaissé leurs taux directeurs : la Fed de 5,25 % à presque 0 % (2007-2008), la BCE de 4,25 % à 1 %, puis à des taux négatifs dès 2014. Cette politique conventionnelle ayant montré ses limites, des mesures non conventionnelles ont été adoptées selon Bernanke & Reinhart (2004) : le *Quantitative easing* (achat massif de titres), le *Qualitative easing* (réallocation d'actifs) et le *Forward guidance* (orientation des anticipations).

Si les deux premières ont contribué à baisser les taux longs et soutenir l'investissement, la troisième politique reste controversée. Fratzscher (2013), Blinder et al. (2016), Borio & Zabai (2016) soulignent ses risques de distorsion. English et al. (2013) montrent qu'elle est plus efficace lorsqu'elle est conditionnée, tandis que Kool & Thornton (2012) en limitent l'impact au court terme. Selon Couppey-Soubeyran & Tripier (2019), ces outils pourraient devenir permanents, bien que l'inflation reste faible malgré les liquidités injectées. Turner (2019) observe que les marchés anticipent des taux bas jusqu'en 2030.

Ces outils comportent aussi des risques : bulles spéculatives, faible rentabilité bancaire, et vulnérabilité accrue. Un relèvement des taux pourrait aggraver la récession, notamment dans les pays surendettés. D'où l'intérêt d'une politique budgétaire active, et d'un nouveau *policy-mix* distinguant stabilité des prix et stabilité financière. Des propositions incluent la « *monnaie hélicoptère* » ou des opérations de refinancement ciblées à long terme conditionnées aux investissements verts (Couppey-Soubeyran, 2020).

5.1.2. Conséquences sociales et politiques des crises financières

5.1.2.1. Conséquences sociales

a. Hausse du chômage et précarisation de l'emploi

L'une des conséquences sociales les plus directes des crises financières est la forte hausse du chômage, liée à la contraction de l'activité économique. Les entreprises, confrontées à une chute de la demande et à des difficultés de financement, procèdent à des suppressions massives d'emplois. Cette situation touche particulièrement les jeunes, les femmes et les travailleurs peu qualifiés. Stiglitz (2010) souligne que la crise de 2008 a engendré « une perte durable d'emplois dans de nombreux pays développés », et que certains travailleurs ne retrouvent jamais un emploi stable. La précarisation se manifeste aussi par le développement des emplois temporaires ou informels.

b. Dégradation des conditions de vie

Le chômage prolongé, combiné à la baisse des revenus et des aides sociales, entraîne une détérioration des conditions de vie pour de larges couches de la population. Fitoussi et Rosanvallon (2011) notent que la crise de 2008 a provoqué une montée de la pauvreté dans les pays de l'OCDE, particulièrement dans les zones urbaines et périphériques. Le logement, l'alimentation, l'accès aux soins et à l'éducation deviennent plus difficiles, avec des conséquences sur la santé mentale et physique des ménages affectés.

c. Montée des inégalités sociales

Les crises financières accentuent les inégalités sociales, en touchant plus fortement les plus vulnérables, alors que les grandes fortunes et les détenteurs d'actifs peuvent souvent se protéger grâce à des placements diversifiés. Selon Piketty (2013), les inégalités de patrimoine ont explosé après 2008, notamment en raison des politiques de sauvetage bancaire et de soutien aux marchés financiers qui ont davantage profité aux plus riches. Ce phénomène alimente une fracture sociale croissante.

d. Perte de confiance et tensions sociales

La multiplication des scandales financiers, les plans de sauvetage jugés inéquitables et l'austérité imposée dans plusieurs pays ont contribué à une défiance croissante envers les institutions politiques et économiques. Giraud (2019) observe que cette crise de légitimité favorise le repli identitaire, la montée des populismes et des mouvements de protestation, parfois violents, comme les « Gilets jaunes » en France.

5.1.2.1. Conséquences politiques

a. Effondrement des systèmes politiques traditionnels et recomposition électorale

La crise financière peut provoquer des transitions politiques brutales : dissolution de gouvernements, élections anticipées ou effondrement des principaux partis. Par exemple, en Grèce en 2012, les partis centristes New Democracy et PASOK se sont effondrés, tandis que Syriza a émergé rapidement comme principale force politique (vote passant de 4 % à 27 %).

*b. Hausse du populisme et montée des partis anti-*establishment

L'insécurité économique post-crise, notamment la hausse durable du chômage, alimente un soutien massif aux partis populistes, souvent à la fois de gauche radicale et d'extrême droite. Algan et al. (2017) démontrent que les régions d'Europe les plus touchées par l'augmentation du chômage connaissaient la plus forte montée du vote populiste. Une étude plus large confirme une augmentation moyenne de 30 % du vote en faveur des partis d'extrême droite après une crise financière sur 140 ans et 20 pays, notamment en Europe.

c. Déclin de la confiance institutionnelle et montée de l'anti-politique

Les crises érodent la confiance dans les institutions publiques, perçues comme subordonnées aux intérêts des élites financières. Guiso et al. (2023) montrent que les individus les plus insécurisés économiquement sont aussi ceux dont la confiance politique est la plus faible, et qu'ils sont plus susceptibles de voter pour des forces anti-établissement. Cette méfiance nourrit la polarisation et fragilise la légitimité démocratique.

d. Risques de dégradation de la démocratie libérale

Les régimes populistes issus des crises peuvent rapidement affaiblir les institutions démocratiques, en limitant les contre-pouvoirs, en restreignant la presse et les droits des minorités. Mudde & Kaltwasser (2017) prévenaient que le populisme, même électoralement légitime, pouvait compromettre la qualité de la démocratie libérale.

e. Instabilité politique prolongée et protestations civiles

La frustration économique et le sentiment d'injustice sociale peuvent mener à des mouvements de protestation prolongés, voire contribuer à des crises politiques majeures. En Grèce, la fragilisation des partis traditionnels a entraîné fragmentation, coalitions instables et mobilisation citoyenne généralisée (ex. Mouvement des indignés). De même, Kriesi (2006) observe que ces protestations, si elles ne débouchent pas rapidement sur du changement, peuvent mener à la radicalisation ou à un désengagement politique généralisé.

5.1.3. Autres conséquences des crises financières

5.1.3.1. Conséquences selon la nature de la crise financière

a. Conséquences des crises bancaires

Les crises bancaires provoquent une contraction immédiate du crédit, une perte de confiance et des faillites bancaires. Le FMI a observé que les crises bancaires précédées d'un fort endettement des ménages et d'une envolée des prix immobiliers sont plus susceptibles d'entraîner des récessions sévères (Meh & Moran, 2008).

Pendant la crise de 2008, les grandes banques américaines et européennes ont perdu plus de milliers de milliards de dollars en actifs toxiques et prêts douteux, ce qui a entraîné un effondrement de la confiance dans la solvabilité des institutions et un gel du crédit. Ce ralentissement du crédit affaiblit rapidement la consommation et l'investissement, amplifiant la baisse du PIB et de l'emploi. Les États doivent alors intervenir massivement, souvent par des plans de sauvetage ou de recapitalisation, ce qui pose à son tour des risques de dette publique.

b. Conséquences des crises monétaires

Les crises monétaires peuvent entraîner une fuite des capitaux, une inflation importée et une perte de compétitivité. Depuis la crise asiatique de 1997, l'attention s'est portée sur la contagion induite par des mouvements spéculatifs sur les devises (Kaminsky & al. 2000). Cette instabilité peut précipiter des crises de dette ou bancaire lorsque les passifs sont libellés en devises.

L'effondrement du baht thaïlandais en 1997 a déclenché une onde de choc dans plusieurs pays asiatiques, provoquant des déclins économiques rapides et des ajustements douloureux pour les entreprises et les gouvernements. La perte de devises étrangères force les Banques centrales à puiser dans leurs réserves, diminuant leur capacité à stabiliser l'économie nationale.

c. Conséquences des crises boursières

Les crashs boursiers entraînent une chute soudaine des actifs financiers, un affaiblissement des bilans des investisseurs et une perte de richesse patrimoniale. Pendant la crise de 2008, de nombreux indices ont chuté de plus de 30 % en peu de temps, provoquant une forte volatilité des

marchés et réduisant les capacités de financement des entreprises. Cette baisse du cours des actions fragilise les banques et les fonds de pension, ce qui conduit souvent à un resserrement du crédit même pour les entreprises non directement exposées aux actifs toxiques. L'assèchement de la liquidité sur les marchés oblige les acteurs à réduire leurs positions, amplifiant la crise de confiance et le risque systémique.

5.1.3.2. Conséquences selon la tendance de croissance d'avant crise

Reinhart & Rogoff (2014) ont montré qu'après une crise financière profonde, le PIB réel met en moyenne 6,5 ans pour revenir à son niveau d'avant-crise, et jusqu'à 8 ans dans les cas les plus sévères. Leur analyse comparative entre pays riches et pauvres est particulièrement pertinente : les économies avancées, dotées d'institutions solides et de marges budgétaires, tendent à retrouver leur niveau de PIB plus rapidement, souvent autour de 5-7 ans. En revanche, les pays à faible croissance d'avant crise ou à infrastructures fragiles peuvent connaître des reprises plus lentes, souvent 8-10 ans ou davantage. Les pays dont la croissance était forte avant la crise peuvent parfois rebondir plus vite si les déséquilibres étaient financiers et non structurels.

5.1.3.3. Conséquences selon l'ampleur de la contagion

L'ampleur de la contagion financière détermine la diffusion du choc initial. Cette contagion peut franchir les frontières via les canaux bancaires, les flux de portefeuilles ou les effets d'interconnexion et d'imitation. Selon les définitions, on distingue la contagion « restreinte », quand elle dépasse les liens fondamentaux et la contagion « générale » quand elle suit des similitudes macro-économiques. Pendant la crise de 2008, les marchés matures (États-Unis, Europe) ont à la fois transmis et reçu des chocs, ce qui montre que la contagion n'est pas cantonnée aux marchés émergents.

Pour les pays africains, l'analyse de Aderajo & Olaniran (2021) sur cinq marchés (Afrique du Sud, Nigeria, Égypte, Kenya, Tunisie) révèle une forte corrélation avec les marchés américains pendant la crise, accentuée par la volatilité et le comportement en troupeau, qui persistent même en période post-crise. Plus l'intégration financière internationale est importante – notamment via les investisseurs internationaux ou les fonds communs – plus la contagion est rapide et profonde.

6. Validation empirique de la théorie de Reinhart et Rogoff (2014)

L'objectif de cette section est de vérifier empiriquement la théorie de Reinhart et Rogoff (2014) selon laquelle des suites d'une crise financière profonde (comme celle de 2008), les pays mettent en moyenne 6,5 ans pour retrouver leur niveau de croissance d'avant-crise et jusqu'à plus de 8 ans dans les cas les plus sévères. Ceci revient à vérifier leur propos selon lequel les pays riches peuvent retrouver plus vite l'équilibre grâce à la force de leur économie contrairement aux pays pauvres qui peuvent faire face à une reprise plus lente.

L'étude va s'articuler autour de deux axes principaux, car nous voulons tester si : (*i*) l'impact négatif de la crise financière internationale de 2008 est très significatif pour nos groupes de pays : effet choc (baisse significative du taux de croissance en 2009 par rapport à celui de 2007) ; et (*ii*) les groupes de pays ont retrouvé leur niveau de croissance d'avant-crise (en mi-2013 soit 6,5 ans après ou plus).

6.1. Présentation de l'échantillon et des méthode/outil statistiques

6.1.1. Présentation de l'échantillon

Notre analyse porte sur un échantillon de 112 pays répartis en deux groupes selon les classifications récentes du Groupe de la Banque mondiale (2024) dont : 87 pays riches ou à revenus élevés (>13 935 $) et 25 pays pauvres ou à revenus faibles (<1 135 $). En fait, nous n'avons pas pris en compte les pays à revenus intermédiaires inférieurs (au nombre de 50 ; entre 1 136 $ et 4 495

$) et les pays à revenus intermédiaires supérieurs (au nombre de 54, entre 4 496 $ et 13 935 $). Notre échantillon de 112 pays est présenté dans le tableau suivant :

Tableau 1 : Représentation de l'échantillon de l'étude

Groupes	Noms des pays
Pays riches	Allemagne, Andorre, Antigua-et-Barbuda, Arabie saoudite, Aruba, Australie, Autriche, Bahamas (Les), Bahreïn, Barbade, Belgique, Bermudes, Brunéi Darussalam, Bulgarie, Canada, Chili, Chypre, Corée du Sud, Costa Rica, Croatie, Curaçao, Danemark, Espagne, Estonie, États-Unis, Émirats arabes unis, Finlande, France, Gibraltar, Grèce, Groenland, Guam, Guyana, Hong Kong (R.A.S. de Chine), Hongrie, Île de Man, Îles Anglo-Normandes, Îles Caïmans, Îles Féroé, Îles Mariannes du Nord, Îles Turques-et-Caïques, Îles Vierges britanniques, Îles Vierges des États-Unis, Irlande, Islande, Israël, Italie, Japon, Koweït, Lettonie, Liechtenstein, Lituanie, Luxembourg, Macao (R.A.S. de Chine), Malte, Monaco, Nauru, Nouvelle-Calédonie, Nouvelle-Zélande, Norvège, Oman, Palaos, Panama, Pays-Bas, Pologne, Polynésie française, Porto Rico, Portugal, Qatar, République tchèque (ou Tchéquie), Roumanie, Royaume-Uni, Russie (Fédération de), Saint-Christophe-et-Niévès, Saint-Marin, Saint-Martin (partie française), Saint-Martin (partie néerlandaise), Samoa américaines, Seychelles, Singapour, Slovaquie, Slovénie, Suède, Suisse, Taïwan (Chine), Trinité-et-Tobago, Uruguay.
Pays pauvres	Afghanistan, Burkina Faso, Burundi, Centrafrique (République centrafricaine), Corée du Nord (République populaire démocratique de Corée), Érythrée, Gambie (La), Guinée-Bissau, Liberia, Madagascar, Malawi, Mali, Mozambique, Niger, Ouganda, République démocratique du Congo, République du Soudan (Soudan), République du Yémen (Yémen), Rwanda, Sierra Leone, Soudan du Sud, Somalie, Syrie (République arabe syrienne), Tchad, Togo.

Source : *World Bank Country and Lending Groups* (2024), *in* https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.

6.1.2. Méthode et outil statistique

6.1.2.1. Méthode statistique : ANOVA à mesures répétées

L'ANOVA (analyse de la variance) à mesures répétées est une méthode statistique permettant de comparer les moyennes d'un même groupe observé à plusieurs moments dans le temps ou dans différentes conditions, en tenant compte de la corrélation entre les mesures, car elles proviennent des mêmes unités (par exemple, les mêmes pays). Développée à partir des travaux de Ronald A. Fisher dans les années 1920-1930, l'ANOVA classique a été étendue aux mesures répétées par Lindquist (1953) et Winer (1971) pour mieux s'adapter aux études longitudinales. Elle est aujourd'hui couramment utilisée en sciences sociales, économiques et médicales. Dans cette étude, l'ANOVA à mesures répétées permet d'analyser : (1) l'effet du temps sur la croissance (entre 2007 et 2009…), (2) l'effet du groupe (pays riches vs pauvres), et (3) l'interaction entre le temps et le type de pays.

6.1.2.2. Outil statistique : Jamovi 2.6.26

Jamovi est un logiciel statistique libre et *open-source*, lancé en 2018 par Jonathan Love, Damian Dropmann et Ravi Selker, pour vulgariser l'analyse statistique en sciences sociales. Basé sur le langage R, il offre une interface intuitive permettant des analyses sans programmation.

Transparent, reproductible et pédagogique, Jamovi propose de nombreux modules.

Dans le cadre de cette étude, Jamovi 2.6.26 est utilisé pour tester les différences de trajectoire de la croissance à travers le temps et entre groupes de pays, à l'aide d'une ANOVA à mesures répétées qui génère automatiquement des tableaux et des graphiques en définissant :

- Le **temps** comme **facteur intra-sujets**.
- Les groupes de **pays** comme **facteur inter-sujets**.
- La **variable qualitative** : les **groupes** (riches et pauvres).
- La **variable dépendante** : **taux de croissance**.

6.2. Mesure de l'effet choc et évaluation de la durée de reprise

6.2.1. Mesure de l'effet-choc

Un premier test vise à évaluer si la chute du taux de croissance des deux groupes de pays entre 2007 (avant crise) et 2009 (après crise) est statistiquement significatif à l'échelle globale et au sein de chaque groupe en utilisant le tableau au format long représenté en Annexe I.

Ce premier test repose sur deux hypothèses fondamentales : (H0) il n'y a pas de différence significative entre les taux de croissance des pays en 2007 et 2009 ; et (H1) il y a une baisse significative des taux de croissance entre 2007 et 2009 à cause de la crise de 2008.

Après avoir exploité ces données sur Jamovi, nous avons eu les résultats suivants :

a. Effets intra-sujets (changements dans le temps)

Anova pour mesures répétées

Effets intra-sujets

	Correction de la spécificité	Somme des carrés	ddl	Carrés moyens	F	p	η^2	η^2_p
Temps	Greenhouse-Geisser	866	1.00	865.6	45.3	<.001	0.122	0.291
	Huynh-Feldt	866	1.00	865.6	45.3	<.001	0.122	0.291
Temps ✻ Groupes	Greenhouse-Geisser	595	1.00	594.7	31.1	<.001	0.084	0.220
	Huynh-Feldt	595	1.00	594.7	31.1	<.001	0.084	0.220
Résidu	Greenhouse-Geisser	2104	110.00	19.1				
	Huynh-Feldt	2104	110.00	19.1				

Note. Somme des carrés de type 3

Nous pouvons conclure d'après ce tableau de résultats issus de Jamovi que par rapport à l' :

- Effet du temps (2007 vs 2009) :
  - $F(1,110) = 45.3$, $p < .001$ → très significatif.
  - Taille d'effet partielle η^2 partiel = 0.291 (taille d'effet forte).

Ainsi, **il y a une baisse significative globale du taux de croissance de PIB réel entre 2007 et 2009.**

- Interaction temps × groupes :
  - $F(1,110) = 31.1$, $p < .001$ → très significatif.
  - η^2 partiel = 0.220 (taille d'effet modérée à forte).

Cela veut dire que **la baisse du taux de croissance diffère significativement entre les groupes de pays riches et pauvres.**

b. Effets inter-sujets (différence entre groupes)

Effets inter-sujets

	Somme des carrés	ddl	Carrés moyens	F	p	η^2	η^2_p
Groupes	761	1	760.9	30.2	<.001	0.107	0.215
Résidu	2775	110	25.2				

Note. Somme des carrés de type 3

Ce tableau issu de Jamovi nous laisse conclure que selon l'effet groupes, nous avons :

- $F(1,110) = 30.2$, $p < .001$ → très significatif.
- η^2 partiel = 0.215 (taille d'effet modérée).

Ce qui signifie que **les groupes de pays (riches et pauvres) ont des niveaux moyens de taux de croissance différents, indépendamment du temps.**

c. Hypothèses et validation

Hypothèses

Tests de sphéricité

	W de Mauchly	p	ε de Greenhouse-Geisser	ε de Huynh-Feldt
Temps [a]	1.00	NaN	1.00	1.00

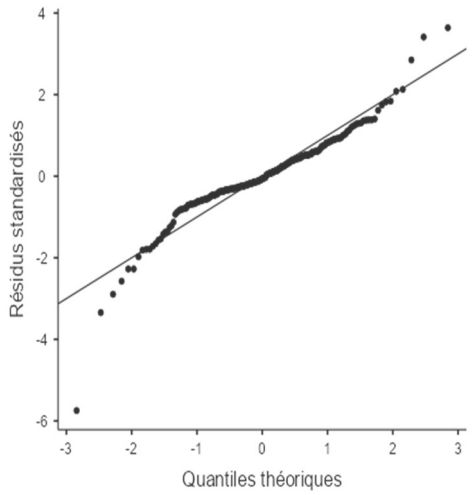
[a] Les mesures répétées n'ont que deux modalités. La condition de sphéricité est automatiquement validée dans ce cas.

Test d'homogénéité des variances (test de Levene)

	F	ddl1	ddl2	p
Avant crise 2007	0.00384	1	110	0.951
Après crise 2009	0.70486	1	110	0.403

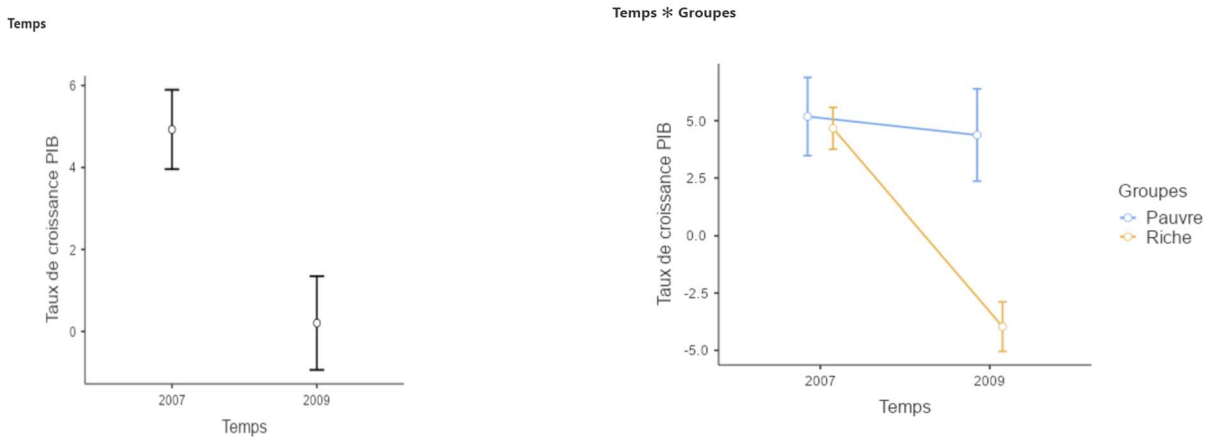
Effectivement, d'après ce tableau issu de Jamovi ; l'hypothèse de :

- **Sphéricité** : est automatiquement validée, car nos mesures sont à deux niveaux.
- **Homogénéité** : est respecté, car p = 0.951 en 2007 et p = 0.403 en 2009. Ce qui veut dire que la variance entre groupes est similaire dans chaque année.
- **Normalité** : est aussi vérifiée, car les points sont proches de la diagonale (malgré quelques écarts dans les extrémités qui ne remettent pas en cause l'ANOVA, car notre échantillon est assez grand renvoyant ainsi à une significativité forte) ; d'après le graphique Q-Q (Quantile-Quantile) suivant :



d. Estimation des moyennes marginales

Estimation des moyennes marginales



Le premier graphique indique qu'en moyenne, le taux de croissance était significativement plus élevé en 2007 qu'en 2009, ce qui reflète un net ralentissement économique mondial après la crise de 2008. Et, le second indique que la baisse du taux de croissance entre 2007 et 2009 a été **beaucoup plus marquée dans les pays riches**, dont la croissance est devenue négative, contrairement aux pays pauvres qui ont maintenu une croissance positive bien que réduite.

Encadré 2 : Analyse globale issu du test sur la mesure de l'effet-choc

Les résultats valident ainsi l'analyse selon laquelle la crise de 2008 a eu un impact différencié selon le niveau de richesse des pays : les ANOVA à mesures répétées révèlent une baisse très significative du taux de croissance entre 2007 et 2009 ($F(1,110) = 45.3$, $p < .001$, $\eta^2_p = 0.291$), avec une interaction temps ✻ groupe également significative ($F(1,110) = 31.1$, $p < .001$, $\eta^2_p = 0.220$), confirmant que les pays riches ont subi un recul plus marqué que les pays pauvres. Ces différences sont appuyées par une variation significative entre groupes ($F(1,110) = 30.2$, $p < .001$, $\eta^2_p = 0.215$), des hypothèses statistiques respectées, et des graphiques montrant une forte chute pour les pays riches, là où les pays pauvres maintiennent une croissance modérée.

=> Ainsi, **le propos de certains auteurs** selon lequel les économies riches, plus interconnectées, subissent

6.2.2. Evaluation de la reprise au bout de 6,5 ans

Pour cela, nous avons utilisé le tableau format long représenté en Annexe II. Ce deuxième test repose sur deux hypothèses : (H0) le taux de croissance de mi-2013 n'a pas retrouvé son niveau de 2007. Et, (H1) le taux de croissance de mi-2013 a retrouvé/dépassé le niveau de 2007.

a. Effets intra-sujets (changements dans le temps)

Anova pour mesures répétées

Effets intra-sujets

	Correction de la spécificité	Somme des carrés	ddl	Carrés moyens	F	p	η^2	η^2_p
Temps	Greenhouse-Geisser	265.13	1.00	265.13	12.075	< .001	0.044	0.099
	Huynh-Feldt	265.13	1.00	265.13	12.075	< .001	0.044	0.099
Temps ✻ Groupes	Greenhouse-Geisser	3.06	1.00	3.06	0.139	0.710	0.001	0.001
	Huynh-Feldt	3.06	1.00	3.06	0.139	0.710	0.001	0.001
Résidu	Greenhouse-Geisser	2415.29	110.00	21.96				
	Huynh-Feldt	2415.29	110.00	21.96				

Note. Somme des carrés de type 3

L'effet principal du facteur temps est significatif avec F(1,110) = 12.075, p < .001, indiquant une différence nette du taux de croissance du PIB entre 2007 et 2013. En revanche, l'interaction temps ✻ groupes n'est pas significative (F = 0.139, p = 0.710), suggérant que l'évolution temporelle est similaire pour les deux groupes (pays riches et pauvres). Ainsi, **le taux de croissance a changé significativement entre 2007 et 2013, mais cette évolution dans le temps est la même pour les pays riches et les pays pauvres.**

b. Facteurs inter-sujets (différence entre groupes)

Effets inter-sujets

	Somme des carrés	ddl	Carrés moyens	F	p	η^2	η^2_p
Groupes	24.5	1	24.5	0.814	0.369	0.004	0.007
Résidu	3309.4	110	30.1				

Note. Somme des carrés de type 3

Ainsi, nous pouvons conclure que :

- La statistique F = 0.814 avec une valeur p = 0.369 (> 0.05) indique que la différence entre les deux groupes n'est pas statistiquement significative.
- L'eta carré (η^2 = 0.004) et l'eta carré partiel (η^2p = 0.007) sont très faibles, ce qui signifie que le groupe (riches ou pauvres) n'explique quasiment rien de la variance totale des taux de croissance du PIB.

En gros, **il n'y a pas de différence significative entre les pays riches et les pays pauvres sur l'ensemble de la période considérée en matière de taux de croissance du PIB.**

c. Hypothèses et validation

Hypothèses

Tests de sphéricité

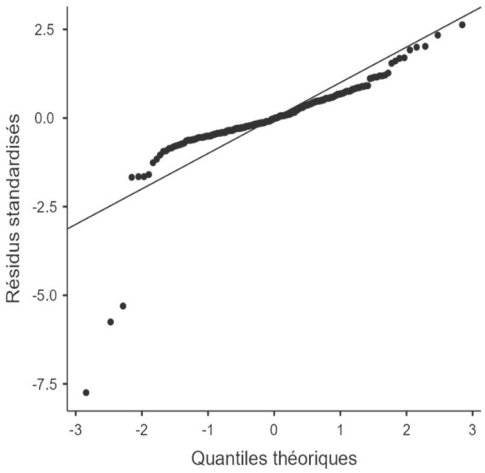
	W de Mauchly	p	ε de Greenhouse-Geisser	ε de Huynh-Feldt
Temps [a]	1.00	NaN	1.00	1.00

[a] Les mesures répétées n'ont que deux modalités. La condition de sphéricité est automatiquement validée dans ce cas.

Test d'homogénéité des variances (test de Levene)

	F	ddl1	ddl2	p
Avant crise 2007	0.00384	1	110	0.951
Après crise mi-2013	10.58124	1	110	0.002

Le test de sphéricité de Mauchly donne W = 1.00 (p non calculée), ce qui signifie que la sphéricité est automatiquement respectée avec deux temps de mesure. Le test de Levene montre que l'homogénéité des variances est respectée avant 2007 (F = 0.00384, p = 0.951), mais violée après 2013 (F = 10.58, p = 0.002) ; ce qui **oblige à la prudence pour les comparaisons intergroupes post-2013**. Et, le graphique Q-Q suivant montre un écart significatif à la normalité, avec plusieurs résidus fortement déviants dans les queues, notamment à gauche, ce qui suggère une distribution asymétrique et la présence de valeurs aberrantes. Ce qui veut dire que la normalité n'est pas vérifiée.

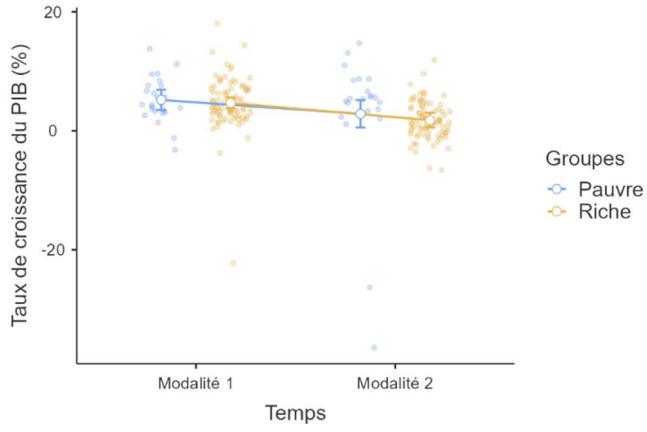


d. Estimation des moyennes marginales

Les moyennes marginales montrent une diminution du score entre les deux modalités temporelles, à la fois pour le groupe « Pauvres » (de 5.18 à 2.85) et le groupe « Riches » (de 4.67 à 1.78), ce qui suggère un effet du temps. Le tableau montre que la croissance a diminué entre 2007 et 2013 aussi bien chez les pays pauvres que chez les pays riches, avec des valeurs moyennes ajustées et une marge d'erreur indiquée par les intervalles de confiance.

Le graphique montre une légère baisse du taux de croissance dans le temps pour les deux groupes, avec une dispersion plus importante chez les pays riches, indiquant une plus grande hétérogénéité de leurs performances économiques.

Temps ✻ Groupes



Estimation des moyennes marginales - Temps ✻ Groupes

				Intervalle de confiance à 95%	
Groupes	Temps	Moyenne	Erreur standard	Borne inf	Supérieur
Pauvre	Modalité 1	5.18	0.861	3.478	6.89
	Modalité 2	2.85	1.158	0.557	5.15
Riche	Modalité 1	4.67	0.461	3.756	5.59
	Modalité 2	1.78	0.621	0.547	3.01

e. Test post-hoc

Tests post hoc

Comparaisons post hoc - Temps

Comparaison							
Temps		Temps	Différence moyenne	Erreur standard	ddl	t	p
Modalité 1	-	Modalité 2	2.61	0.752	110	3.47	< .001

Comparaisons post hoc - Groupes

Comparaison							
Groupes		Groupes	Différence moyenne	Erreur standard	ddl	t	p
Pauvre	-	Riche	0.794	0.880	110	0.902	0.369

Comparaisons post hoc - Temps ✻ Groupes

Comparaison									
Temps	Groupes		Temps	Groupes	Différence moyenne	Erreur standard	ddl	t	p
Modalité 1	Pauvre	-	Modalité 1	Riche	0.513	0.977	110	0.526	0.600
		-	Modalité 2	Pauvre	2.332	1.325	110	1.760	0.081
		-	Modalité 2	Riche	3.407	1.061	110	3.210	0.002
	Riche	-	Modalité 2	Pauvre	1.819	1.247	110	1.459	0.147
		-	Modalité 2	Riche	2.893	0.710	110	4.073	< .001
Modalité 2	Pauvre	-	Modalité 2	Riche	1.075	1.314	110	0.818	0.415

Les tests post hoc montrent qu'entre 2007 et mi-2013, la baisse des taux de croissance économique est significative pour l'ensemble des pays ($p < .001$), mais elle est surtout marquée chez les pays riches ($p < .001$), tandis que la baisse chez les pays pauvres est moins nette ($p = 0.081$, non significative). Cela suggère que les pays pauvres ont mieux retrouvé leur niveau d'avant-crise que les pays riches ; 6,5 ans après la crise financière internationale de 2008.

Encadré 3 : Analyse globale issu du test sur l'évaluation de la reprise au bout de 6,5 ans

L'ANOVA à mesures répétées montre un effet significatif du temps sur les taux de croissance entre 2007 et mi-2013 ($F(1,110)=12.075$, $p<.001$, $\eta^2p=0.099$), tandis que ni l'effet du groupe (pauvres vs riches) ($F=0.814$, $p=0.369$) ni l'interaction Temps ✻ Groupe ($F=0.139$, $p=0.710$) ne sont significatifs. Les moyennes marginales indiquent une baisse du taux moyen chez les pauvres (de 5.18 à 2.85) comme chez les riches (de 4.67 à 1.78), mais seule la diminution est statistiquement significative chez les pays riches (différence = 3.41, $p=0.002$), suggérant qu'eux seuls n'ont pas retrouvé leur niveau d'avant-crise.

=> Ainsi, **le propos de ces auteurs** selon lequel les pays riches – dotées d'institutions solides et de marges budgétaires – retrouvent plus vite l'équilibre d'avant-crise (5 à 7 ans), contrairement aux pays pauvres avec

7. Discussions

7.1. Validation théorique et perspectives de recherches futures

Notre recherche a mis en lumière deux grands résultats après confrontation des données empiriques sur les taux de croissance des deux groupes de pays : pauvres et riches, suite à la crise de 2008. Effectivement, (1) l'existence d'effet-choc a été prouvée, car cette crise de 2008 a entraîné une chute brutale de la croissance pour ces deux groupes, car il y a eu une différence très significative entre les taux de 2007 (avant crise) et ceux de 2009 (après crise). Nous avons pu constater aussi que (2) la crise de 2008 a impacté d'une manière différenciée les économies des pays riches et pauvres. Autrement dit, plus de 6,5 ans après la crise, seuls les pays pauvres semblent avoir retrouvé leur niveau de croissance d'avant, tandis que les pays riches continuent de subir une baisse significative de leur croissance c'est-à-dire qu'ils n'ont pas pu enregistrer un retour à la normale.

Ce qui infirme empiriquement les propos de Reinhart & Rogoff (2014), car dans ces pays à revenus élevés, ayant des économies très interconnectées, ladite crise s'est accompagnée d'une période de croissance économique plus lente et d'une augmentation de la dette publique avec un temps de récupération plus long que ce qui est généralement anticipé. Ce qui fait qu'il est nécessaire encore de vérifier le temps de reprise pour les pays riches avec une période plus longue de plus d'une décennie après la crise de 2008 et d'intégrer d'autres variables d'analyses comme la dette publique...

Toutes nos hypothèses de recherche ont ainsi été validées, car nous avons pu prouver que : (H1) la crise financière internationale de 2008 a provoqué une baisse significative du taux de croissance du PIB mondial ; (H2) cette baisse est plus prononcée dans les pays à revenu élevé, même 6,5 ans après (qui signifie une non reprise) que dans les pays à faible revenu, (H3) les pays riches ont mis plus de temps à retrouver leur niveau de PIB réel d'avant-crise que les pays pauvres (temps de reprise plus élevé à tester dans une recherche future). Enfin, (H4) il existe une interaction significative entre le temps et le niveau de revenu dans l'évolution du PIB.

7.2. Leçons tirées par les instances internationales après la crise financière de 2008

À la suite de la crise de 2008, les grandes Banques centrales (Fed, BCE,...) ont tiré des leçons en renforçant leur indépendance, en déployant des outils monétaires non conventionnels (liquidités illimitées, refinancement à long terme, achats d'actifs) et en réformant le secteur bancaire. Parallèlement, les institutions internationales comme le FMI, la Banque mondiale, l'OCDE ou le Comité de Bâle (via Bâle III) ont renforcé la coordination, la surveillance et la régulation financière mondiale. L'Union européenne et d'autres acteurs ont établi des normes de gouvernance et de transparence, tandis que les États ont transposé ces recommandations dans leurs lois nationales.

8. Conclusion

Cette étude revisite les crises financières internationales en mobilisant une approche à la fois historique, théorique et empirique, centrée sur la crise systémique de 2008. Elle distingue les grandes typologies de crises et mobilise divers cadres d'analyse pour mieux comprendre les dynamiques de déclenchement et de propagation. L'analyse empirique repose sur les taux de croissance de 112 pays classés selon leur niveau de revenu, dans le but de tester les conclusions de Reinhart et Rogoff (2014), selon lesquelles les pays riches seraient plus rapides à retrouver l'équilibre post-crise.

Or, les résultats des tests ANOVA à mesures répétées contredisent cette hypothèse. Seuls les pays pauvres semblent avoir retrouvé leur rythme de croissance antérieur sept ans après la crise, tandis que les pays à revenu élevé affichent encore des pertes significatives. De plus, la chute du taux de croissance entre 2007 et 2009 a été statistiquement significative, avec un impact plus marqué sur les économies avancées.

Sur le plan des politiques, l'étude met en évidence des réponses fortes apportées par les Banques centrales (comme la Fed et la BCE) : utilisation d'instruments non conventionnels, renforcement de l'autonomie monétaire et réforme des structures bancaires. Les États et institutions internationales ont également agi à travers des réformes macroprudentielles, réglementaires et de coopération.

Mais face aux crises récentes (crise bancaire en 2023, tensions géopolitiques...), une interrogation demeure : *les réformes post-2008 ont-elles suffi à construire un système financier réellement résilient, ou les fragilités persistent-elles sous de nouvelles formes ?*

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Annexes

Annexe I : Tableau format long utilisé pour la mesure de l'effet-choc.

Pays	Groupes	Avant crise 2007	Après crise 2009
Allemagne	Riche	2.9	-5.5
Andorre	Riche	1.6	-5.3
Antigua-et-Barbuda	Riche	9.3	-12
Arabie saoudite	Riche	2.2	-1.1
Aruba	Riche	3.1	-11.7
Australie	Riche	3.8	1.9
Autriche	Riche	3.8	-3.6
Bahamas (Les)	Riche	1.4	-4.6
Bahreïn	Riche	8.3	2.5
Barbade	Riche	2.1	-5
Belgique	Riche	3.7	-1.9
Bermudes	Riche	3.3	-5.6
Brunéi Darussalam	Riche	-3.8	-1.9
Bulgarie	Riche	6.7	-3.3
Canada	Riche	2	-2.9
Chili	Riche	5.2	-1.1
Chypre	Riche	5.1	-2
Corée du Sud	Riche	5.8	0.8
Costa Rica	Riche	8.2	-0.9
Croatie	Riche	5	-6.8
Curaçao	Riche	2.5	-0.5
Danemark	Riche	1	-5
Espagne	Riche	3.5	-3.8
Estonie	Riche	7.6	-14.6
États-Unis	Riche	2	-2.6
Émirats arabes unis	Riche	3.2	-5.2
Finlande	Riche	5.3	-8.1
France	Riche	2.5	-2.8
Gibraltar	Riche	8.8	-5.2
Grèce	Riche	3.5	-4.1
Groenland	Riche	2.4	0.9
Guam	Riche	0.7	0.4
Guyana	Riche	7.2	3.6
Hong Kong (R.A.S. de Chine)	Riche	6.46	-2.7
Hongrie	Riche	0.3	-6.7
Île de Man	Riche	7.5	2.1
Îles Anglo-Normandes	Riche	7.5	2.5
Îles Caïmans	Riche	3.2	-7.2
Îles Féroé	Riche	3.5	-4.6
Îles Mariannes du Nord	Riche	3.7	-17.5

Îles Turques-et-Caïques	Riche	3.6	-19.6
Îles Vierges britanniques	Riche	4	-13.2
Îles Vierges des États-Unis	Riche	4	-6.6
Irlande	Riche	5.3	-5.1
Islande	Riche	8.5	-7.7
Israël	Riche	6.3	1.2
Italie	Riche	1.5	-5.3
Japon	Riche	1.5	-5.7
Koweït	Riche	6	-7.1
Lettonie	Riche	10.4	-16
Liechtenstein	Riche	3.3	-1.2
Lituanie	Riche	11.1	-14.6
Luxembourg	Riche	8.1	-3.2
Macao (R.A.S. de Chine)	Riche	4.5	1.3
Malte	Riche	5	-1.4
Monaco	Riche	14.4	-11.3
Nauru	Riche	-22.2	-5.7
Nouvelle-Calédonie	Riche	3.5	2.4
Nouvelle-Zélande	Riche	3.1	0
Norvège	Riche	2.9	-1.9
Oman	Riche	5	6
Palaos	Riche	1.8	-7.3
Panama	Riche	13.2	1.6
Pays-Bas	Riche	3.9	-3.7
Pologne	Riche	6.8	2.6
Polynésie française	Riche	1.7	-4.2
Porto Rico	Riche	-1.2	-2
Portugal	Riche	2.5	-3.1
Qatar	Riche	18	12
République tchèque (ou Tchéquie)	Riche	5.5	-4.8
Roumanie	Riche	7.2	-5.5
Royaume-Uni	Riche	2.6	-4.6
Russie (Fédération de)	Riche	8.5	-7.8
Saint-Christophe-et-Niévès	Riche	2.9	-1.2
Saint-Marin	Riche	7.1	-10.3
Saint-Martin (partie française)	Riche	6.5	-10.6
Saint-Martin (partie néerlandaise)	Riche	4.5	-2
Samoa américaines	Riche	1.9	-4.2
Seychelles	Riche	8.9	-2.5
Singapour	Riche	9	0.1

Slovaquie	Riche	10.8	-5.5
Slovénie	Riche	7.1	-7.6
Suède	Riche	3.2	-4.3
Suisse	Riche	3.9	-2.3
Taïwan (Chine)	Riche	6.9	-1.6
Trinité-et-Tobago	Riche	4.8	-4.4
Uruguay	Riche	6.5	4.2
Afghanistan	Pauvre	13.8	21.4
Burkina Faso	Pauvre	4.1	3
Burundi	Pauvre	3.5	3.8
République centrafricaine	Pauvre	4.6	8.6
Corée du Nord	Pauvre	-3,2	-0.9
Érythrée	Pauvre	1,4	3.9
Gambie (La)	Pauvre	3	6.7
Guinée-Bissau	Pauvre	2,6	2.4
Libéria	Pauvre	9,5	5.3
Madagascar	Pauvre	5,7	-4
Malawi	Pauvre	9,6	8.3
Mali	Pauvre	3,9	4.6
Mozambique	Pauvre	7,6	5.9
Niger	Pauvre	3,1	2
Ouganda	Pauvre	8,4	6.8
République dém. du Congo	Pauvre	6,3	2.9
Soudan	Pauvre	5,7	-2.8
Yémen (République du)	Pauvre	3,3	3.9
Rwanda	Pauvre	7,6	6.2
Sierra Leone	Pauvre	3,7	1.5
Soudan du Sud	Pauvre	11,2	5
Somalie	Pauvre	6,7	6.7
Syrie (République arabe syrienne)	Pauvre	4,3	4
Tchad	Pauvre	4,4	-1.3
Togo	Pauvre	-1,2	5.5

Source : Croissance du PIB (% annuel). Données des comptes nationaux de la Banque mondiale et fichiers de données des comptes nationaux de l'OCDE. Tous les pays et économies. https://donnees.banquemondiale.org/indicateur/NY.GDP.MKTP.KD.ZG?end=2009&start=2007

Annexe II : Tableau format long utilisé pour l'évaluation de la reprise.

Pays	Groupes	Avant crise 2007	Après crise mi-2013
Allemagne	Riche	2.9	0,4
Andorre	Riche	1.6	-3,5
Antigua-et-Barbuda	Riche	9.3	-0,6
Arabie saoudite	Riche	2.2	2,9
Aruba	Riche	3.1	6,4
Australie	Riche	3.8	2,6
Autriche	Riche	3.8	-0,3
Bahamas (Les)	Riche	1.4	-2,9
Bahreïn	Riche	8.3	5,3
Barbade	Riche	2.1	-1
Belgique	Riche	3.7	0,3
Bermudes	Riche	3.3	-0,3
Brunéi Darussalam	Riche	-3.8	-2,1
Bulgarie	Riche	6.7	-0,5
Canada	Riche	2	2,3
Chili	Riche	5.2	3,3
Chypre	Riche	5.1	-6,6
Corée du Sud	Riche	5.8	3,2
Costa Rica	Riche	8.2	2,5
Croatie	Riche	5	-0,1
Curaçao	Riche	2.5	-0,6
Danemark	Riche	1	1,4
Espagne	Riche	3.5	-1,4
Estonie	Riche	7.6	1,8
États-Unis	Riche	2	2,1
Émirats arabes unis	Riche	3.2	5,2
Finlande	Riche	5.3	-1
France	Riche	2.5	0,8
Gibraltar	Riche	8.8	7,8
Grèce	Riche	3.5	-2,3
Groenland	Riche	2.4	-1,3
Guam	Riche	0.7	1,7
Guyana	Riche	7.2	3,7
Hong Kong (R.A.S. de Chine)	Riche	6.46	3
Hongrie	Riche	0.3	2
Île de Man	Riche	7.5	4,1
Îles Anglo-Normandes	Riche	7.5	0,5
Îles Caïmans	Riche	3.2	1,3
Îles Féroé	Riche	3.5	5,9
Îles Mariannes du Nord	Riche	3.7	4,4
Îles Turques-et-Caïques	Riche	3.6	1,1

Îles Vierges britanniques	Riche	4	1,6
Îles Vierges des États-Unis	Riche	4	-6,3
Irlande	Riche	5.3	2,2
Islande	Riche	8.5	4,6
Israël	Riche	6.3	4,1
Italie	Riche	1.5	-1,8
Japon	Riche	1.5	2
Koweït	Riche	6	1,1
Lettonie	Riche	10.4	2,1
Liechtenstein	Riche	3.3	4,9
Lituanie	Riche	11.1	4
Luxembourg	Riche	8.1	3,2
Macao (R.A.S. de Chine)	Riche	4.5	11,9
Malte	Riche	5	6,3
Monaco	Riche	14.4	9,6
Nauru	Riche	-22.2	3,6
Nouvelle-Calédonie	Riche	3.5	5,1
Nouvelle-Zélande	Riche	3.1	2,6
Norvège	Riche	2.9	1
Oman	Riche	5	5,2
Palaos	Riche	1.8	-3
Panama	Riche	13.2	6,3
Pays-Bas	Riche	3.9	0
Pologne	Riche	6.8	0,7
Polynésie française	Riche	1.7	0,4
Porto Rico	Riche	-1.2	-0,3
Portugal	Riche	2.5	-1
Qatar	Riche	18	5,6
République tchèque (ou Tchéquie)	Riche	5.5	0
Roumanie	Riche	7.2	0,3
Royaume-Uni	Riche	2.6	1,8
Russie (Fédération de)	Riche	8.5	1,3
Saint-Christophe-et-Niévès	Riche	2.9	5,7
Saint-Marin	Riche	7.1	-0,8
Saint-Martin (partie française)	Riche	6.5	1,42
Saint-Martin (partie néerlandaise)	Riche	4.5	1,3
Samoa américaines	Riche	1.9	-2,5
Seychelles	Riche	8.9	1,3
Singapour	Riche	9	4,8
Slovaquie	Riche	10.8	0,7
Slovénie	Riche	7.1	-0,8

Suède	Riche	3.2	1,1
Suisse	Riche	3.9	1,8
Taïwan (Chine)	Riche	6.9	2,11
Trinité-et-Tobago	Riche	4.8	3,3
Uruguay	Riche	6.5	4,6
Afghanistan	Pauvre	13.8	5,6
Burkina Faso	Pauvre	4.1	5,8
Burundi	Pauvre	3.5	4,9
République centrafricaine	Pauvre	4.6	-36,4
Corée du Nord	Pauvre	-3,2	1,1
Érythrée	Pauvre	1,4	8,7
Gambie (La)	Pauvre	3	2,9
Guinée-Bissau	Pauvre	2,6	3,3
Libéria	Pauvre	9,5	8,7
Madagascar	Pauvre	5,7	2,3
Malawi	Pauvre	9,6	5,4
Mali	Pauvre	3,9	2,4
Mozambique	Pauvre	7,6	6,6
Niger	Pauvre	3,1	5,3
Ouganda	Pauvre	8,4	3,6
République dém. du Congo	Pauvre	6,3	8,5
Soudan	Pauvre	5,7	2
Yémen (République du)	Pauvre	3,3	4,8
Rwanda	Pauvre	7,6	4,7
Sierra Leone	Pauvre	3,7	14,7
Soudan du Sud	Pauvre	11,2	13,1
Somalie	Pauvre	6,7	11
Syrie (République arabe syrienne)	Pauvre	4,3	-26,3
Tchad	Pauvre	4,4	2,8
Togo	Pauvre	-1,2	5,8

Source : op. cit.

From Directive Control to Adaptive Strategy: A Comparative Analysis of Strategic Planning Mechanisms for Effective Governance

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Abstract
In the face of the ongoing instability of the global economy, organizations need to be able to effectively formulate and implement strategies in order to survive and succeed. Traditional models of long-term planning are giving way to more flexible and adaptive approaches. This paper aims to compare two fundamentally different, but equally successful, strategic planning mechanisms: the cascaded, process-oriented Hoshin Kanri system (using Toyota as an example), and the decentralized, results-oriented model (using Netflix as an example). The paper uses the methodology of case study analysis to explore how these mechanisms link high-level strategies with operational activities, influence staff engagement, and shape organizational culture. The analysis results indicate that the Toyota model, which is based on the principles of continuous improvement and two-way communication, provides the highest level of operational efficiency and quality in a complex manufacturing environment. This model is based on "freedom and responsibility", and provides a strategic context instead of simply cascading tasks. This approach drives innovation and speed at Netflix, a company that operates in a creative and rapidly evolving industry. The study concludes that there is not a single "best" management model. The effectiveness of a particular model depends on its alignment with the industry's context, the organization's culture, and the company's strategic priorities.

Keywords: strategic planning, effective management, Hoshin Kanri, OKR (goals and key results), adaptive strategy, Toyota, Netflix.

Introduction

Strategic planning is a crucial component of effective organizational management. It involves defining long-term objectives and strategies to achieve them, as well as allocating resources and adapting to external changes. However, in today's rapidly changing and uncertain world, traditional approaches to strategic planning that rely on long-term static plans are increasingly criticized. Modern leaders face the challenge of not only creating a strategy, but also building a system that ensures its implementation across all levels of the organization and allows for flexible responses to unexpected situations [1], [2]. The challenges of research: The gap between strategy formulation and implementation remains a major management challenge. It is estimated that up to 70% of strategic initiatives fail, not because of poor strategy, but due to ineffective execution [3], [4]. This suggests a lack of planning mechanisms - systems, processes, and cultural norms - that translate top management's vision into concrete actions and measurable

outcomes. There are numerous models (MBO, BSC, OKR, Hoshin Kanri), but limited comparative studies analyzing how these mechanisms work in different, successful companies [5], [6], [7], [8], [9]. The aim of this research is to conduct a comparative analysis of two contrasting but effective strategic planning models using Toyota and Netflix as case studies. Our goal is to identify the key components, benefits, and contextual limitations of these models [10], [11].

Objectives: to systematize the theoretical foundation of strategic planning techniques. To analyze the Hoshin Kanri method at Toyota as a case study of a cascading, process-driven model. To examine the adaptive context management approach in Netflix as a model of a decentralized, outcome-focused system [12]. Compare these two methods based on key parameters such as goal setting, implementation process, control system, and cultural impact [13]. Formulate conclusions about the suitability of each model for different situations [14].

Methods

The study was conducted within the framework of a qualitative comparative case study methodology [15]. This method allows for an in-depth and comprehensive examination of two organizations that represent prominent examples of different strategic planning approaches.

The selection of cases: The choice of organizations was determined by their distinctiveness and recognized success:

Toyota Motor Corporation: A global leader in the automotive industry and the benchmark for production efficiency and quality. Toyota is the founder and the most successful practitioner of the Hoshin Kanri system, which translates as "management compass" or "policy deployment," an integrated strategy cascading mechanism closely linked with the philosophy of continuous improvement (Kaizen).

Netflix, Inc. is a global leader in the streaming entertainment industry, known for its unique corporate culture that rejects traditional control and planning methods in favor of a more flexible and decentralized approach. This approach can be described as "contextual management," where leaders provide teams with all the information and they need to make independent decisions, rather than imposing goals and objectives from above. This is similar to the Objectives and Key Results (OKR) philosophy, which emphasizes action and results over planning and control. The analysis is based on a variety of data sources, including official company reports, books, articles, and academic research. These include the work of Reed Hastings and Taiichi Ono, as well as research on the Toyota production system and the Netflix culture.

To compare the two approaches, we will look at four key dimensions:

The goal setting process: How are high-level goals formulated? (Top-down vs. bottom-up approach).

Cascading mechanism: How is the strategy communicated to employees?

Monitoring and control system: How is progress tracked and action plans adjusted?

Impact on culture and motivation: How does the system affect employee behavior and engagement?

Results

The analysis of the two cases reveals fundamental differences in approaches to strategic planning.

Case 1: Toyota and the Hoshin Kanri mechanism

Hoshin Kanri is not just a planning tool, but an integrated system that permeates the entire organization.

Table 1. Key stages of the Hoshin Kanri mechanism in Toyota

Stage	Description	Tools and Methods
1. Vision Formulation	Top management defines a long-term vision (5–10 years) and breakthrough annual goals.	Strategic workshops, external environment analysis
2. “Catchball” (Nemawashi)	Objectives are passed down the hierarchy. Mid-level managers discuss, adjust KPIs, and return proposals upward. This iterative process continues across all levels.	Affinity diagrams, A3 reports, consultation meetings
3. Deployment	After alignment, annual goals are translated into specific projects and individual tasks.	X-matrices, project roadmaps
4. Monitoring and Control	Monthly and quarterly progress reviews at all levels.	Visual dashboards, regular reporting
5. Correction (PDCA Cycle)	Annual analysis identifies deviations and lessons learned, feeding into the next planning cycle.	PDCA cycle, root cause analysis

This system creates a powerful vertical connection in the organization. Each employee understands how their work contributes to the achievement of common goals. The key element — "catchball" — provides two-way communication, increasing the realism of plans and the involvement of performers.

Case 2: Netflix and adaptive context management

Netflix has deliberately abandoned most of the traditional planning and control mechanisms. Instead of cascading goals, Netflix's leadership focuses on creating a strategic context. Leaders (from Reed Hastings to department heads) constantly and openly share their vision of the market, the competitive situation, strategic priorities and challenges. Their goal is not to give the team instructions, but to provide it with the same information and understanding that they themselves possess.

The key principles of this mechanism are:

Hiring "stars": The system works only if there are highly professional and motivated employees.

Maximum transparency: Radical honesty and openness in communication. Any employee has access to a wide range of information about the company's status.

Decentralization of decisions: Teams, having context, independently make decisions and make "bets". Some of them turn out to be unsuccessful, and this is considered a normal part of the innovation process.

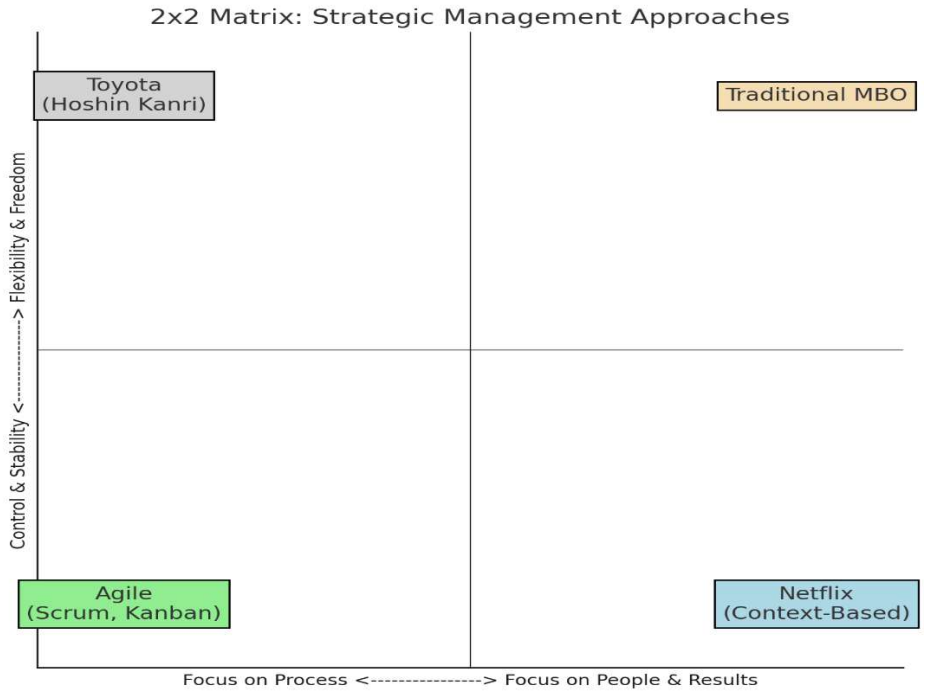
Control through the result: Instead of controlling the process (for example, accounting for working hours), focus on the result. An employee's effectiveness is assessed through a "Keeper Test": "Will I fight for this person if he wants to leave?".

Comparative analysis and visualization

Table 2. Comparative analysis of Toyota and Netflix planning mechanisms

Parameter	Toyota (Hoshin Kanri)	Netflix (Context-Based Management)
Philosophy	Continuous improvement (Kaizen) and respect for people	Freedom and responsibility
Goal Setting	Cascading with two-way alignment ("catchball" process)	North Star orientation (general direction rather than specific goals)
Process	Highly structured and formalized (PDCA cycle)	Flexible and informal
Focus of Control	Process control to ensure quality and predictability	Outcome control and talent density
Decision-Making	Consensus-based and collective	Decentralized and autonomous
Error Response	Root cause analysis for process improvement	Acceptance as part of innovation, learning from failure

Figure 1. Positioning of strategic planning mechanisms



Discussion

Interpretation of the results: A comparison between Toyota and Netflix reveals that there is no single, universally applicable strategic planning model. The effectiveness of a model depends on its alignment with the organization's goals and environment. The Toyota approach is ideal for complex, capital-intensive industries where the cost of mistakes is high, and stability, quality, and predictability are crucial for success. Hoshin Kanri enables perfect coordination of a large organization, guiding thousands of employees towards gradual but steady improvement. Netflix's approach is best suited for creative, rapidly changing industries where innovation speed and boldness are key advantages. A rigid planning and control system would stifle creativity and hinder decision-making speed. A culture that values flexibility and freedom attracts and retains top talent, fostering innovation.

Theoretical and practical implications.

Theoretical contribution: The study supports the theory of organizational randomness, which suggests that there are no universal management principles; the optimal structure and processes of an organization depend on external and internal factors. It also illustrates the practical application of Peter Drucker's idea of turning a mission into specific goals.

Practical recommendations: Managers should avoid blindly copying popular systems, such as OKR from Google or Hoshin Kanri from Toyota. Instead, they should analyze their own company and industry to determine what works best.

For organizations in stable, complex industries such as industry and energy, Hoshin Kanri's elements, including clear cascading, process focus, and PDCA, may be more effective. For organizations in dynamic and creative industries such as IT, media, and R&D, the principles of the Netflix model, including hiring strong specialists, providing context, and delegating decisions, can bring significant benefits. While a hybrid approach, combining a clear strategic direction like Toyota's with a high degree of team autonomy like Netflix's, may be optimal for most companies.

Conclusion

Strategic planning mechanisms are evolving from rigid policy systems to more flexible and adaptive models. A comparative analysis of Toyota and Netflix has shown two poles of this spectrum, each of which has proven to be highly effective in the relevant context. Toyota achieves success through process discipline and collective improvement. Netflix — through the density of talent and freedom of decision-making. The main lesson for modern leaders is that their main task is not to choose and implement a fashionable tool, but to design an integrated system (strategy—culture-process-people) that will allow their organization to thrive in its unique environment. The choice between directive and adaptation is a strategic choice that determines the company's future.

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Corporate Culture as a Driver of Organizational Performance: Comparative Analysis of Alibaba and Uzum

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Abstract: in the era of digital transformation—particularly across the "New Silk Road" corridor—corporate culture has emerged as a decisive factor shaping the pace and scale of success for tech companies. This study explores how organizational culture influences performance by comparing two emblematic firms at different stages of maturity: the global powerhouse Alibaba Group (China) and Central Asia's first tech unicorn, Uzum (Uzbekistan). Using a comparative case study approach and the Competing Values Framework, the research illustrates how distinct cultural models can drive exceptional outcomes. Alibaba's success stems from a fusion of mission-driven values and adaptive transformation, while Uzum thrives on a culture of rapid responsiveness and market agility. Supported by comparative data tables, the study argues that cultural effectiveness is directly tied to how well it aligns with market dynamics and strategic goals.

Keywords: corporate culture, organizational performance, Alibaba Group, Uzum, comparative analysis, digital economy, China, Central Asia, customer-centricity

Introduction

In the modern era, the success of an organization is no longer solely dependent on its physical assets. Instead, it is determined by its capacity for innovation, agility, and the strength of its customer relationships. At the heart of these capabilities lies the corporate culture. This thesis is particularly relevant when examining emerging economic powerhouses like China and Central Asian nations. These regions, united by the Belt and Road Initiative, have become a hub for the rapid growth of digital commerce, where the cultural identity of companies shapes their trajectory. The objective of this research is to conduct a comprehensive comparative study of the influence of two distinct corporate cultures on organizational performance, using the case studies of Alibaba Group and Uzum as examples. Organizational culture is widely recognized as a critical factor influencing a company's strategic performance, employee engagement, and adaptability to change. Numerous studies underscore the importance of strong corporate culture in fostering long-term sustainability and innovation [1], [2]. This paper examines the impact of corporate culture on organizational effectiveness through a comparative case study of two distinct companies: Alibaba Group and Uzum.

Alibaba Group, one of the world's leading e-commerce and technology conglomerates, has embedded Confucian values such as harmony, hierarchy, and collective responsibility into its organizational culture [3], [4]. These values, deeply rooted in Chinese tradition, shape leadership practices and employee behavior. According to Cameron and Quinn's competing values framework, Alibaba exemplifies a **Clan** and **Adhocracy** culture, emphasizing collaboration, innovation, and internal development [5]. This cultural orientation is supported by regular 1-on-1 meetings, mentorship programs, and employee empowerment mechanisms [6].

Research questions:

Q1: What are the fundamental principles and cultural beliefs that have contributed to Alibaba Group's long-term success and global expansion?

Q2: What aspects of the company's culture enabled Uzum to achieve unicorn status and establish a dominant position in the Uzbek market in a remarkably short time?

Q3: What strategic conclusions can be drawn from comparing the culture of a mature global giant and an aggressive regional leader for other companies operating in the digital economy?

Methods

The work is based on the methodology of qualitative comparative case study. This approach allows for a deep, contextual analysis of two representative organizations.

Alibaba Group: Selected as one of the founders and global leaders of the digital economy. Its complex ecosystem (e-commerce, fintech, logistics, cloud) and the unique culture established by Jack Ma are a textbook example of building a long-term competitive advantage.

Uzum: Selected as the brightest and fastest growing technology project in Central Asia. The company achieved a valuation of $1 billion in less than two years, building an ecosystem much like Alibaba's early model, but adapted to the local realities of Uzbekistan.

The analysis is based on secondary sources, including: annual company reports, communications with shareholders, public appearances by founders and CEOs, academic research on Alibaba, and articles in reputable business publications (Financial Times, The Wall Street Journal, Forbes, Spot.uz). To organize the analysis, we have employed Cameron and Quinn's model of competing values, which examines culture through the lens of two axes: "flexibility versus control" and "internal focus versus external focus," resulting in four cultural types (clan, adhocracy, hierarchy, and market).

Results

In contrast, Uzum, a fast-growing Uzbek e-commerce platform, has emerged as a regional “unicorn” and exhibits a more Market-oriented culture focused on performance, agility, and customer satisfaction [7], [8]. However, its rapid growth has exposed challenges in sustaining employee engagement and internal leadership pipelines [9]. Data from HR audits conducted in 2023 revealed high staff turnover (85%) and low eNPS scores (–15), linked to the lack of a systematic adaptation process and a top-down management style. To address these issues, Uzum initiated a cultural transformation project in 2024, inspired partly by Alibaba’s internal development model. This included the implementation of an ATS system for faster recruitment, introduction of “refer-a-friend” programs, and leadership development tracks to foster internal mobility. The strategic use of organizational culture as a performance lever is evident in both cases. Alibaba’s success is also attributed to its consistent alignment between cultural values and technological innovation, described by Zeng as “smart business” principles for the digital age. Moreover, the company's annual report highlights culture as a core intangible asset driving international expansion [10]. Uzum, meanwhile, reflects the dynamics of a post-Soviet startup ecosystem undergoing digital transformation. As noted by Iskakov and Sultanov, the phenomenon of “leapfrogging” allows such companies to adopt advanced technologies rapidly, bypassing legacy systems [11]. Yet, sustaining this advantage requires a strong cultural backbone—a challenge still being addressed in Uzbekistan’s broader innovation strategy [12]. Academic frameworks such as Hofstede’s cultural dimensions [13] and Denison’s model of organizational culture help compare the cross-cultural dynamics between Alibaba and Uzum. For example, Uzbekistan’s high power distance and uncertainty avoidance influence managerial practices at Uzum, whereas Alibaba balances hierarchy with employee voice and decentralized innovation. Ultimately, this comparative analysis demonstrates that corporate culture is not only a reflection of national

values but also a strategic asset for scaling innovation, building resilient teams, and driving competitive advantage [14], [8].

Case 1: Alibaba Group — A culture of mission, values, and continuous adaptation. Alibaba's culture has always been its most valuable intangible asset.

Dominant: The Culture of Mission and Market. Alibaba has had a powerful mission from the very beginning: "To make it easy to do business anywhere" ("To make doing business easy anywhere in the world"). The focus on helping small and medium-sized businesses (external, market focus) was not just a slogan, but the basis of the strategy.

Values as the basis of Coherence: Famous values ("Six Veils of the Spiritual Sword", and later updated versions), such as "Customers come first, employees come second, shareholders come third", served as an internal compass and ensured coherence in a huge and diversified organization.

Adaptability (Adhocracy): Despite its huge size, the company demonstrated an amazing ability to adapt and transform itself. The creation of Taobao, the launch of Alipay to solve the problem of distrust, investments in logistics (Cainiao) and cloud computing (Alibaba Cloud) are all examples of successful adaptation to new challenges.

Engagement (Clan): Alibaba's culture is a blend of high standards and elements of clan culture, fostering a strong sense of community, a deep connection to the "Ali Family," and unique corporate traditions.

Case 2: Uzum: A Culture of Extreme Adaptability and Speed

Uzum is a culture model that prioritizes rapid market capture. The core of Uzum's culture is agility. The company launched key services in record time: e-commerce (Uzum Market), fintech (Uzum Bank), BNPL service (Uzum Nasiya), and food delivery (Uzum Tezkor). This is a classic adhocracy where flexibility, innovation, and risk-taking are highly valued.

Market Focus: The company's entire strategy is centered around solving specific problems faced by Uzbek consumers: the lack of convenient delivery, the low penetration of banking services, and the need for simple installment payment options. The customer-centric approach here is not just a slogan, but a fundamental principle.

Collaboration and Stability: These aspects are currently being developed and are focused on achieving the primary objective — efficiency. The organizational structure is decentralized, with small, self-sufficient teams. Stability is ensured through a shared vision among leaders and a unified technological framework, rather than through standardized protocols.

The comparative analysis between Alibaba and Uzum reveals distinct cultural profiles shaped by their respective strategic contexts. Table 1 provides a structured breakdown of their cultural dimensions based on Cameron and Quinn’s competing values framework. While Alibaba demonstrates a balanced integration of Clan, Adhocracy, and Market cultures, Uzum is characterized by a pure Adhocracy-Market orientation, prioritizing speed and adaptability over process and tradition. The comparison highlights how Alibaba's mature organizational design allows for sustainable innovation and long-term coherence, whereas Uzum’s cultural agility facilitates rapid market penetration but creates challenges in internal stability.

Table 1. Comparative Analysis of the Cultural Profiles of Alibaba and Uzum

Cultural Aspect	Alibaba Group	Uzum	Key Difference
Dominant Cultural Type	Market / Adhocracy (with elements of Clan and Hierarchy)	Adhocracy / Market (in a pure, aggressive form)	Balance and maturity vs. Speed and focus
Strategic Driver	Long-term mission and core values	Solving immediate customer problems and speed-to-market	Visionary orientation vs. Pragmatism
Innovation Process	Structured innovation, creation of new business units (e.g., Alibaba Cloud)	Fast replication and localization of proven models (super app)	Invention vs. Rapid implementation
Attitude Toward Risk	Managed risk and diversification	High risk tolerance for the sake of speed	Scalable growth vs. Market capture
Core Asset	Ecosystem and trust built over decades	Speed of deployment and deep localization	Accumulated power vs. Tactical advantage

This comparison illustrates how cultural configurations reflect strategic choices and organizational maturity.

Table 2 presents key indicators of organizational effectiveness and market performance. It demonstrates the massive scale difference between the two companies—Alibaba's trillion-dollar GMV and global reach contrast sharply with Uzum's nascent but fast-growing market in Uzbekistan. Despite its recent foundation in 2022, Uzum has achieved unicorn status in under two years, emphasizing the power of technological leapfrogging and localized innovation. However, the data also suggests structural challenges in talent retention and internal processes that may hinder long-term resilience if not addressed.

Table 2. Key Indicators of Organizational Effectiveness (Estimated and Actual Figures for 2023–2024)

Indicator	Alibaba Group	Uzum	Comment
Year of Foundation (Core Business)	1999	2022	Maturity gap of 23 years
Market Capitalization / Valuation	~$180 billion	> $1.1 billion	Scale difference, yet both are leaders in their segments
Annual Ecosystem GMV	> $1.2 trillion	> $200 million (2024 forecast)	Demonstrates Alibaba's dominance and Uzum's rapid growth
Number of Active Customers	> 1 billion (globally)	> 10 million (Uzbekistan)	Strong market penetration in respective geographies
Time to Unicorn Status	~6 years (est. in 2005)	< 2 years	Reflects Uzum's "technological leap" and market momentum
Key Ecosystem Services	E-commerce, Fintech, Cloud, Logistics, Media	E-commerce, Fintech, BNPL, Food delivery	Uzum mirrors Alibaba's path, but on an accelerated timeline

Sources: Alibaba Annual Reports, NASDAQ data; Uzum press releases, Forbes, Spot.uz.

Discussion

Comparing Alibaba and Uzum clearly demonstrates how different cultural models lead to success in different contexts. Alibaba's culture, based on a great mission and unshakable values, has allowed the company to survive several crises, build a complex ecosystem and become a global giant. Her adaptability manifested itself in strategic, well-thought-out steps. Uzum culture is a blitzkrieg culture. In the conditions of the "blue ocean" in the Uzbek market, where there were no dominant players, it was speed, flexibility and accurate hitting of the client's pain points that became decisive factors. The company has deliberately sacrificed the construction of complex procedures for the sake of maximum acceleration.

Practical implications for management: effectiveness is contextual: Uzum's success proves that young markets do not have to copy the complex corporate cultures of giants. At the stage of market capture, the culture of adhocracy (flexibility, speed) can be more effective. Cultural evolution: as the business grows and becomes more complex, Uzum will inevitably face a challenge that Alibaba solved earlier: how to maintain speed and innovation, but at the same time build more sustainable processes and strong internal values (Consistency). The lesson for global players is that by entering markets like Central Asia, global companies should not impose their complex culture, but create more flexible and autonomous local teams capable of operating at the speed of local competitors such as Uzum.

Conclusion

The comparative analysis of Alibaba and Uzum reveals that corporate culture is not a one-size-fits-all model, but rather a contextual factor that can provide a competitive advantage. While Alibaba's mission-driven, value-centered culture acts as a long-term engine for strategic alignment, resilience, and cohesion among employees, Uzum's culture reflects the dynamic nature of a high-growth startup in a developing market, characterized by flexibility, experimentation, and swift execution. Both models have their own advantages and disadvantages. Alibaba's structured innovation processes and focus on internal consistency may slow down short-term response times, but they ensure long-term scalability. On the other hand, Uzum's rapid growth has exposed cultural weaknesses such as high turnover rates and a lack of formal leadership pipelines.

Based on this analysis, we recommend the following strategic implications for emerging market startups like Uzum:

1. Emphasize cultural alignment: To ensure long-term success, startups should align their culture with the broader business goals and values. This can be achieved through clear communication, transparency, and a shared vision.

2. Foster a culture of innovation: Startups should encourage experimentation and creativity to drive growth and innovation. This can help them stay ahead of the competition and adapt to changing market conditions.

3. Invest in leadership development: Startups need to establish formal leadership pipelines to ensure continuity and stability. This includes investing in training and development programs for current and future leaders.

Gradually introduce cultural anchors (shared values, onboarding rituals, leadership development programs) to support sustainable growth without stifling progress. Implement feedback loops (regular eNPS tracking, cross-functional team reviews) to reduce turnover and enhance internal engagement. For established companies entering new markets (like Alibaba in Central Asia), avoid imposing rigid cultural frameworks. Instead, empower local teams to create context-specific adaptations of core values. Encourage decentralized decision-making and rapid experimentation in frontier markets to maintain competitiveness with fast-growing regional players. Policymakers and ecosystem builders can support startup ecosystems by providing culture-sensitive infrastructure. This includes leadership education, innovation hubs, and founder

support tailored to local needs. Foster platforms for knowledge sharing between global giants and local innovators to create hybrid innovation models. Ultimately, the ability to dynamically align culture with market conditions - combining the visionary depth of Alibaba with the tactical speed of Uzum - represents a strategic frontier for organizations navigating both global and local challenges.

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Philosophical Sciences

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РЕЛИГИОЗНОЕ ОБРАЗОВАНИЕ: ИСТОРИЯ, ТРАДИЦИИ И СОВРЕМЕННОСТЬ

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Резюме
Религиозное образование представляет собой сложное явление, охватывающее духовную, нравственную, культурную и правовую сферы жизни общества. Его значение трудно переоценить в условиях глобализации, роста межконфессиональных контактов и вызовов религиозного радикализма. Исторически религиозное образование выполняло функции сохранения и трансляции сакрального знания, морального воспитания и социального регулирования.
Статья освещает эволюцию религиозного образования, его формы в традиционных и современных обществах, а также роль религии в формировании общественного сознания, правового поля и межкультурного диалога, особенно в контексте постсоветского пространства и Азербайджана.
Ключевые слова: религия, образование, культура, общество, межкультурный диалог, нравственные ценности.

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RELIGIOUS EDUCATION: HISTORY, TRADITIONS AND MODERNITY

Resume
Religious education is a complex phenomenon that encompasses the spiritual, moral, cultural, and legal spheres of society. Its importance cannot be overestimated in the context of globalization, the growth of interfaith contacts and the challenges of religious radicalism. Historically, religious education has served the functions of preserving and broadcasting sacred knowledge, moral education, and social regulation.
The article highlights the evolution of religious education, its forms in traditional and modern societies, as well as the role of religion in shaping public consciousness, the legal framework and intercultural dialogue, especially in the context of the post-Soviet space and Azerbaijan.
Key words: religion, education, culture, society, intercultural dialogue, moral values.

Религиозное воспитание, как действенное явление, на протяжении всей истории играло важную роль в построении общества, формировании нравственных ценностей, сохранении духовной культуры. В этой связи исторически всегда было востребовано религиозное образование, которое перманентно меняло свои формы, методы и методологию преподавания религиозного знания.

В мировой практике религиозное образование реализуется на основе нескольких моделей: 1) конфессиональной модели; 2) плюралистической модели; 3) модели сравнительных религий; 4) академического подхода. Каждая модель имеет аспекты, которые соответствуют определенным методам и образовательным целям.

Богословский, философский, социологический, психолого-педагогический подходы влияют на методологию религиозного образования. Эти подходы многогранно раскрывают механизмы влияния религии на человеческое поведение, сознание и общество.

Свобода вероисповедания, право на религиозное образование, статус религиозных общин защищены конституцией Азербайджана и законом «Об образовании». Этот аспект обеспечивает баланс между религиозным нейтралитетом государства и религиозными свободами граждан.

Религиозное образование и социальное развитие

Религиозное воспитание укрепляет структуру общества в целом, формируя социальную нравственную культуру. Это важно с точки зрения гражданской ответственности, общественного мнения и системы ценностей.

На постсоветском пространстве восстанавливается уничтоженная атеистическим этапом система религиозного образования. Есть структурная проблема, нехватка кадров, методологическая неопределенность, политические манипуляции. Но новые конституционные положения, признание религиозных свобод способны создать возможности для продвижения в позитивном направлении.

Закон «О свободе совести» сыграл важную роль в формировании правовой основы истории независимости Азербайджана и религиозного образования. Принятый в 1992 году одним из первых правовых документов независимого Азербайджана этот закон определил правовые основы религиозных свобод и заложил конституционную основу для религиозного образования, свободы вероисповедания и деятельности религиозных общин. Вместе с законом уточнялись отношения религии и государства, устанавливался принцип нейтралитета государства в отношении религиозных организаций и свободы вероисповедания граждан. Этот исторический документ стал поворотным с точки зрения повышения религиозной грамотности, организации религиозного образования и развития религиозного плюрализма в Азербайджане.

В дальнейшем в отношении религиозных ценностей в Азербайджанской Республике на переднем плане стояли принципы баланса, регулирования и свободы вероисповедания. Проводя политику позитивного религиозного просвещения, государство предприняло серьезные шаги по предотвращению религиозного радикализма, повышению религиозной грамотности, проведены реформы, направленные на сохранение религиозной терпимости, продвижение образовательных и просветительских программ. Так, был создан Государственного комитета по делам религий и законодательно определены деятельность Управления мусульман Кавказа и взаимодействие между этими двумя структурами, занимающимися проблемами религии в стране.

Религиозная неграмотность – одно из условий роста фанатизма, суеверия, радикализма. Борьба с ним может проводится через научно-религиозное просвещение, поощрение позитивных религиозных лидеров и контроль над прессой.

Пресса, социальные сети играют двойственную роль в распространении религиозного образования: как средство позитивного образования, так и средство манипулирования радикальной и ложной информацией.

Технологии искусственного интеллекта открывают новые возможности в области анализа религиозных текстов, создания обучающих платформ, управления архивами религиозной информации.

Религиозное образование входит в важные социальные институты формирования личности: через формальные программы в школе, через естественное наследие ценностей в семье, через продвижение религиозных лидеров в местах поклонения.

Таким образом, религиозное образование есть и «было способом понимания людьми самих себя, Вселенной и социальных структур» (Мамедов А.Ш., *Религиозное образование: история, традиции и современность*, Баку: НИПЦ, 2023, с. 4), а плюралистические подходы к религиозному образованию «необходимы для поощрения межрелигиозного диалога и культурной интеграции» (там же, с. 11).

Религиозное образование остаётся важнейшим элементом формирования личности, гражданского сознания и общественной сплочённости. Его устойчивое развитие требует баланса между правовыми основами, этическими стандартами и современными образовательными технологиями.

Историко-культурные основы религиозного образования

С древнейших времён религия служила основой образования. В античных культурах, таких как Египет и Месопотамия, обучение священнослужителей было связано с религиозными храмами. В средневековой Европе монастырские школы стали прообразами университетов. Исламский мир создал собственную систему религиозного образования через медресе, начиная с IX века (Мусин Р. А. *История религий*, М.: Аспект Пресс, 2005, с. 131).

Религиозное образование включало не только богословие, но и основы морали, права, философии. Оно закладывало основы мировоззрения и формировало представления о добре и зле, человеке и обществе, смысле жизни и смерти (Мамедов А.Ш., *Религиозное образование*, 2023, с. 4).

Современные трансформации и правовые аспекты

В условиях светского государства религиозное образование должно быть адаптировано к правовым и образовательным стандартам. Законодательство Азербайджана ("О свободе религиозных вероисповеданий", 1992) предусматривает право на получение религиозного образования, одновременно регулируя формы его реализации.

По мнению В. Федотова, "государство не может быть нейтральным к духовному воспитанию граждан, но обязано обеспечить его соответствие конституционным нормам" (*Религия и право*, М., 2010, с. 97).

В Азербайджане религиозное образование осуществляется в рамках светского законодательства, но с учётом традиционной исламской культуры и межконфессионального диалога (Мамедов А.Ш., с. 18).

Сравнительный анализ христианского и исламского религиозного образования

Исторические корни

Христианское религиозное образование развивалось в монастырских и приходских школах. Византия, а затем Европа эпохи Средневековья видели в нём средство не только духовного просвещения, но и социальной мобилизации. Важнейшим элементом христианского образования стало изучение Священного Писания и патристики.

Исламское образование, начиная с медресе, было направлено на изучение Корана, хадисов, фикха, калама и арабского языка. Медресе с ранних веков стали центрами не только религиозного, но и светского образования (Беннаби М. *Мусульманская мысль и образование*, Каир, 1973, с. 62).

Современное состояние

Сегодня христианское образование в Европе переживает кризис идентичности и секуляризации, хотя в православных странах (например, в России и Греции) наблюдается его возрождение.

В исламском мире религиозное образование сталкивается с вызовами фундаментализма и необходимостью модернизации. В Азербайджане осуществляется постепенная интеграция светского и религиозного компонентов, основанная на национальных и духовных ценностях. Специфика именно азербайджанской модели образования заключена в синтезе плюрализма, светскости, духовности, толерантности, мультикультурализма.

Перспективы развития религиозного образования

Современные вызовы - глобализация, радикализм, утрата ценностей - требуют новой концепции религиозного образования. Оно должно стать:

- диалогичным и плюралистичным;
- ориентированным на духовно-нравственное воспитание;
- интегрированным с технологиями, включая ИИ и цифровые платформы (см. Мамедов А.Ш., с. 26);
- нацеленным на профилактику экстремизма и развитие критического мышления.

Ключевым фактором сегодня, как и в прошлом, является профессиональная подготовка педагогов и духовных лидеров.

Экуменизм и религиозное образование

Экуменизм - движение за единство христианских церквей - оказывает влияние и на образовательные модели. В последние десятилетия наблюдается рост межконфессиональных программ в университетах, развитие сравнительного религиоведения, распространение межрелигиозного диалога в школах (Сидоров А. *Экуменизм и образование*, М., 2012, с. 44).

В Азербайджане политика мультикультурализма способствует формированию экуменического сознания. Здесь активно взаимодействуют исламские, христианские и иудейские общины. Религиозное образование рассматривается как средство мирного сосуществования и культурной интеграции (Мамедов А.Ш., с. 22).

Религиозное образование остаётся важнейшим инструментом духовного развития, гражданского воспитания и общественного согласия. Его развитие должно сочетать верность традиции с инновациями, уважение к свободе совести с защитой от радикализма, духовные цели с академическим качеством. В этом смысле Азербайджан представляет уникальный опыт гармоничного сосуществования религии и светского общества.

Сравнительный анализ религиозного образования в постсоветских странах

Россия

В России религиозное образование развивается в рамках сотрудничества между государством и традиционными конфессиями, прежде всего РПЦ. В 2009 году в школах была введена дисциплина "Основы религиозных культур и светской этики". Существует также развитая система духовных семинарий и академий. Как отмечает З. Клементьев, "религиозное образование в России продолжает восстанавливаться после десятилетий

гонений и идеологического давления" (*Православное образование в современной России*, М., 2016, с. 58).

Казахстан

Казахстан осуществляет религиозное образование в рамках политики светского государства, но признаёт важность традиционного ислама и православия. Основными формами религиозного обучения являются медресе и духовные школы. Государство лицензирует религиозные учебные заведения. По словам А. Абдуали, "в Казахстане сложилась модель умеренного религиозного образования, ориентированного на толерантность и профилактику экстремизма" (*Религия и общество в Казахстане*, Алматы, 2014, с. 112).

Грузия

В Грузии ключевую роль играет Грузинская православная церковь. С 1990-х годов были восстановлены духовные академии и семинарии. В школах введён курс религиозной культуры. Согласно Г. Церетели, "религиозное образование в Грузии активно поддерживается церковью и пользуется доверием населения" (*Церковь и образование в Грузии*, Тбилиси, 2017, с. 34).

Украина

В Украине религиозное образование осуществляется в контексте плюрализма - действуют учебные заведения как православных церквей, так и католической и протестантских общин. В университетах существуют факультеты теологии. По мнению В. Еленского, "Украина является примером демократической модели религиозного образования в постсоветском пространстве" (*Религия после СССР*, Киев, 2015, с. 73).

Современное религиозное образование в христианских и мусульманских странах:

Общее:

1. *Возрождение религиозного образования в постсекулярную эпоху*

   В эпоху глобализации и культурных конфликтов религиозное образование приобретает новое значение - как средство формирования идентичности, нравственности и культурной преемственности.

2. *Двойственность модели образования*

   Почти повсеместно религиозное образование существует в двух формах:

   Формальное (институциональное): теологические факультеты, духовные семинарии, исламские университеты.

   Неформальное: воскресные школы, мадрасе, курсы при мечетях и церквях.

3. *Конфликт между секулярным и конфессиональным*

   Государственные системы образования часто стремятся к нейтралитету, но под давлением общественных или политических сил включают элементы религиозного содержания (напр. преподавание религиозной культуры, истории религий).

4. *Рост транснациональных влияний*

   Влияние Ватикана, Аль-Азхара, Саудовской Аравии, Турции, Ирана, протестантских миссий и др. ведет к унификации или политизации религиозного образования.

Особенное:

Христианские страны (в первую очередь католические и православные):

В католических странах (например, Польша, Италия, Испания) религиозное образование зачастую интегрировано в школьную систему (предмет «религия»).

В православных странах (Греция, Сербия, Румыния) государство тесно сотрудничает с церковью, но степень обязательности религиозного компонента варьируется.

В протестантских странах (Германия, Швеция) – акцент делается на изучение религии как культуры или философии, а не конфессии.

Мусульманские страны:

Религиозное образование глубже интегрировано в государственные и частные институты. В некоторых странах (Саудовская Аравия, Иран) оно занимает центральное место в школьной системе.

В Турции и Тунисе реализуются светские реформы (в Турции - система имам-хатибов, двойная модель).

В ряде стран (Пакистан, Египет) - смешанная модель с высоким влиянием традиционных мадрасе и спонсируемых из-за рубежа учебных программ.

Религиозное образование в бывших советских странах

Общие черты:

1. *Постатеистический ренессанс*

После распада СССР произошло резкое увеличение интереса к религии и созданию религиозных учебных заведений - семинарий, мадрасе, воскресных школ.

2. *Разнообразие конфессий и культур*

Сосуществование православия, ислама (суннизм, шиизм, суфизм), иудаизма, буддизма, католицизма, протестантизма на фоне сложной этнической мозаики.

3. *Слабость институциональных структур*

Во многих странах нет чёткой системы религиозного образования; кадры неподготовлены, учебники разрозненные, влияние зарубежных центров остаётся сильным.

4. *Государственное регулирование*

Многие страны (Азербайджан, Россия, Казахстан, Узбекистан) контролируют религиозное образование через лицензирование, аккредитацию и ограничение влияния "иностранных" идеологий.

Специфика по регионам:

Россия:

Введены основы религиозных культур и светской этики в школах.

Есть духовные академии, семинарии, исламские университеты (Болгарская исламская академия, Российский исламский институт).

Влияние РПЦ велико в системе образования и в общественном пространстве.

Центральная Азия (Казахстан, Узбекистан, Кыргызстан):

Активное развитие исламского образования, при этом жёсткий контроль за радикализацией.

Часто религиозное образование ограничено неформальными структурами и зарубежными влияниями (Турция, Иран, Пакистан, арабские страны).

В Узбекистане и Туркменистане - значительное вмешательство государства в назначение имамов и содержание образования.

Кавказ (Азербайджан, Армения, Грузия):

В Азербайджане - исламское образование под контролем государства, обучение на религиозных факультетах, попытки сбалансировать шиитское и суннитское влияние.

В Армении и Грузии - приоритет национальной церкви (АПЦ, Грузинская ПЦ), постепенная институционализация религиозного образования.

Универсальная модель религиозного образования в плюралистическом обществе

Такая модель возможна при соблюдении *строгих условий баланса, нейтралитета и диалога*. Она должна быть интегративной, модульной и диалогической.

Основные принципы универсальной модели

Принцип	Суть
Светский нейтралитет	Образование не проповедует, а изучает религии как культурные и мировоззренческие системы
Межконфессиональность	Представление всех главных религий на равных началах
Диалогическая педагогика	Обсуждение, дискуссия, проблемные ситуации, сравнение
Инклюзивность	Уважение к неверующим, агностикам и философским мировоззрениям
Модульность	Возможность углубленного изучения религий по выбору ученика/семьи

Заключение

Современные проблемы религиозного образования требуют решения целого ряда вопросов:

Какую методологию следует применить для создания основ религиозного воспитания и образования?

Как религиозное образование влияет на межкультурный и межрелигиозный диалог?

Можно ли создать универсальную модель религиозного образования для многоконфессионального общества?

Каковы перспективы применения искусственного интеллекта в религиозном образовании?

Каково будущее религиозного образования в контексте этики, развития технологий, глобализации и локальных идентичностей.

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Philological Sciences

Struktural Dilçilik: Sinxron və Diaxron Yanaşmaların İnkişafı və Əhəmiyyəti

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Xülasə

Bu məqalədə struktural dilçiliyin meydana çıxması və onun həm sinxron, həm də diaxron dilçilikdəki əhəmiyyəti təhlil edilir. Ferdinand de Saussure-un dilin sistem kimi qəbul edilməsi konsepsiyası, fonemlərin struktur və funksional təbiətinin yenidən qiymətləndirilməsinə səbəb olmuş, bununla da fonetikadan fonologiyaya keçid baş vermişdir. Roman Jakobson, Nikolay Trubetzkoy və digər dilçilərin fonemlərin ayırdedici xüsusiyyətlər sisteminə əsaslanaraq tədqiqi, dil dəyişikliklərinin sistemli və qarşılıqlı əlaqəli proses kimi öyrənilməsinə yol açmışdır.

Abstract

This article analyzes the emergence of structural linguistics and its significance in both synchronic and diachronic linguistics. Ferdinand de Saussure's conceptualization of language as a system led to a re-evaluation of the structural and functional nature of phonemes, thus enabling the transition from phonetics to phonology. The studies of Roman Jakobson, Nikolai Trubetzkoy, and other linguists on phonemes as systems of distinctive features have paved the way for understanding language change as a systematic and interrelated process.

Açar sözlər: struktur dilçilik, diaxron, sinxron, fonem, fərqləndirici xüsusiyyətlər.
Keywords: structural linguistics, diachronic, synchronic, phoneme, distinctive features.

XX əsrin əvvəllərində dilçilik sahəsində əsas dönüş nöqtəsi struktural dilçiliyin yaranması ilə bağlıdır. Bu yeni yanaşma, dilin klassik təsvirindən fərqli olaraq, onu bütöv və qarşılıqlı əlaqəli elementlərdən ibarət sistem kimi dərk etməyə imkan verdi. Ferdinand de Saussure-un təməl ideyası, dili sadəcə elementlərin cəmi deyil, həm də bu elementlər arasındakı əlaqələrin məcmusu olaraq qiymətləndirmək idi. O, dilin sistem olduğunu bildirərkən, bu termini əvvəllər istifadə edilən səslərin və ya sözlərin siyahısından fərqli olaraq, dərin struktur münasibətlərini ifadə etmək üçün istifadə etdi (Saussure, 1959, s. 67–70).

Saussure dilin həm sinxron (zaman baxımından müəyyən bir anın dili), həm də diaxron (dil tarixində zamanla baş verən dəyişikliklər) təhlilini ayırdı. O, həmçinin paradigmatik və sintagmatik münasibətləri müəyyənləşdirdi — bunlar dilin elementlərinin necə seçildiyini və yerləşdirildiyini açıqlayan əlaqələrdir. Bu baxış bucağı, sonrakı illərdə fonologiyanın və diaxron dilçiliyin inkişafında əsas rol oynadı.

Fonemlərin mahiyyəti Saussure tərəfindən "əks, nisbi və qarşılıqlı fərqləndirici" vahidlər kimi təsvir edilmişdir. Bu fikrə görə, fonemlər təkcə öz akustik və artikulyator xüsusiyyətlərinə görə deyil, həm də digər fonemlərlə olan qarşılıqlı münasibətlərinə görə müəyyənləşdirilir (Saussure, 1959, s. 119).

Bu nəzəriyyənin inkişafında yalnız Saussure deyil, həmçinin J.N. Baudouin de Courtenay, L.V. Şçerba, Edward Sapir, Leonard Bloomfield, Daniel Jones, N.S. Trubetzkoy və Roman Jakobson kimi önəmli dilçilər böyük töhfələr vermişdir. Onlar fonemlərin struktur və funksional aspektlərini genişləndirərək, fonemləri müəyyən xüsusiyyətlərin yığılımı kimi təhlil etməyə başladılar.

Roman Jakobson 1932-ci ildə fonemi “fərqləndirici xüsusiyyətlər toplusu” (distinctive features) kimi təqdim etdi və bu yanaşma günümüzdə də geniş qəbul olunur (Jakobson, Fant və Halle, 1952, s. 4–8). Bu, fonemlərin təkcə özünün deyil, həm də digər fonemlərlə fərqlənmə prinsiplərinin sistemli təsvirinə şərait yaratdı. N.S. Trubetzkoy fonemlərin qarşılıqlı fərqləndirici xüsusiyyətlərini sistemli şəkildə təsnif edərək, fonoloji sistemin ümumi strukturunu ortaya qoydu (Trubetzkoy, 1939, s. 60–85).

Jakobsonun binarizm prinsipi, yəni fonoloji xüsusiyyətlərin ikili (məsələn, səsli/səssiz, qalın/incə) qarşıdurmalarla təsvir edilməsi, fonologiyanın universal qanunlarını müəyyənləşdirməkdə mühüm rol oynadı. Gunnar Fant və Morris Halle ilə birlikdə hazırladıqları model fonemlərin xüsusiyyətlərinin akustik və artikulyator xüsusiyyətlər baxımından sistemləşdirilməsi və bu xüsusiyyətlərin dillər üzrə seçimi kimi məsələləri əhatə etdi (Jakobson, Fant və Halle, 1952; 1962).

Struktural dilçiliyin sinxron sahədə əldə etdiyi nailiyyətlər diaxron dilçilik sahəsinə də əhəmiyyətli təsir göstərdi. Saussure dil dəyişikliklərinin əsasən fonetik səviyyədə olduğunu vurğulasa da, onun yanaşması bu dəyişiklikləri daha geniş sistem kontekstində araşdırmaq baxımından məhdud idi. O, qrammatik dəyişiklikləri analoji proses kimi qəbul etmiş və semantik dəyişikliklərə isə az diqqət yetirmişdir (Saussure, 1959, s. 83–90).

1920-30-cu illərdə Roman Jakobson, N.S. Trubetzkoy və Evgeni Polivanov kimi alimlər dil dəyişikliklərinin sistemli və qarşılıqlı əlaqəli proseslər olduğunu irəli sürdülər. Onlar fonem dəyişikliklərinin sadəcə səs səviyyəsində deyil, bütöv fonoloji sistemin dəyişməsi kimi baş verdiyini göstərdilər. Bu, dilin dəyişməsinin yalnız fərdi vahidlərə deyil, sistemin bütövlüyünə təsir göstərdiyini vurğuladı (Jakobson, 1929, s. 10–20).

Jakobson fonoloji sistemlərin tarazlıq və stabillik prinsipinə əsaslandığını, sistemdə tarazlıq pozulduqda isə balansı bərpa etmək üçün dil dəyişikliklərinin baş verdiyini vurğuladı. Bu prosesdə hər dəyişiklik yeni balanssızlıq yaratmaq potensialına malikdir və beləliklə, dil sistemində davamlı bir tarazlıq və yenidənqurma prosesi gedir (Jakobson, 1962, s. 210–220).

Bu yanaşma diaxron fonologiyanın inkişafına səbəb oldu və fonoloji sistemin dəyişmələrinin yalnız səslərdə deyil, morfoloji və semantik səviyyələrdə də sistemli şəkildə baş verdiyini göstərdi. Beləliklə, dil dəyişmələri təkcə təsadüfi proseslər deyil, sistemin funksional və tarazlıq prinsiplərinə uyğun baş verən mürəkkəb qarşılıqlı əlaqələr toplusudur (Trubetzkoy, 1939, s. 90–110).

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THE INFLUENCE OF LINGUISTIC THEORY ON ENGLISH LANGUAGE TEACHING: A CRITICAL PERSPECTIVE

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Introduction

Linguistics, understood as the scientific exploration of language, has grown into a foundational discipline for modern language education. As English maintains its status as a global lingua franca, educators increasingly rely on linguistic theory to enhance teaching methodologies and design effective curricula. Rather than remaining an abstract academic field, linguistics has offered concrete tools that shape practical classroom strategies. This paper critically explores the diverse ways in which linguistic theories and subfields inform and influence English Language Teaching (ELT), offering both conceptual frameworks and applied teaching solutions.

1. The Role of Linguistic Theory in English Language Teaching

Theoretical linguistics has long played a pivotal role in informing ELT methodologies. Structuralism, generativism, and functionalism have each left a significant imprint on pedagogical practices. Structuralist theory, with its focus on identifying recurring patterns and systems in language, led to methodologies such as the audio-lingual approach, where repetition and pattern drills were employed to reinforce language habits. Although no longer dominant, its legacy continues in pronunciation and grammar drills.

Generative grammar, championed by Noam Chomsky, revolutionized language education by emphasizing the internal cognitive mechanisms behind language acquisition. This shift laid the groundwork for communicative language teaching, where meaningful input and interaction take precedence over mechanical practice.

Functional linguistics, particularly through the work of M.A.K. Halliday, brought attention to the social purposes of language. It encourages ELT to be context-sensitive and learner-focused, advocating for instruction that reflects real-life communicative needs. Teachers guided by this framework prioritize meaningful discourse over isolated grammar points.

2. Phonology in Pronunciation Teaching

Phonology—the study of sound systems—is a cornerstone of pronunciation instruction. A firm grasp of phonological principles enables educators to help students overcome common pronunciation challenges. Phonemic awareness, stress patterns, intonation, and rhythm are all vital for intelligible speech. Phonemic transcription and minimal pair activities (e.g., distinguishing between /i:/ and /ɪ/ in "sheep" vs. "ship") are widely used to develop students' auditory discrimination. In addition, features of connected speech such as assimilation, elision, and linking play a key role in understanding fluent English. Teachers who incorporate these elements into listening and speaking activities equip students with tools to comprehend and produce more natural spoken language.

3. Morphology and Vocabulary Development

Morphology, the study of word formation, is essential for effective vocabulary instruction. Teaching students about morphemes—the smallest units of meaning—enables them to decipher complex or unfamiliar words. For instance, understanding that "bio" pertains to life helps students intuit meanings of words like "biography," "biology," or "antibiotic." Educators apply

morphological strategies such as affix analysis, word families, and morphological trees to improve learners' lexical awareness. This approach not only facilitates vocabulary acquisition but also strengthens reading comprehension and spelling.

4. Syntax and Grammar Instruction

Syntax, which examines how words are combined into meaningful sentences, directly informs grammar pedagogy. Syntax-oriented instruction moves beyond rote memorization to emphasize the underlying structure of language. Sentence modeling, transformation drills, and syntactic awareness tasks help learners internalize complex constructions.

A descriptive rather than prescriptive view of grammar, supported by linguistic syntax, also acknowledges the diversity of English usage. Students exposed to varied sentence types and real-world language samples become better communicators, capable of adapting grammar to different contexts.

5. Semantics and Meaning-Making

Semantics, the study of meaning, is integral to vocabulary development and comprehension. Teachers use semantic frameworks to explain nuances such as polysemy, synonymy, antonymy, and ambiguity. For example, understanding the dual meanings of the word "bank" (financial institution vs. riverbank) is crucial for accurate interpretation. Instructional strategies include semantic mapping, lexical set categorization, and paraphrasing tasks. These activities not only expand students' word knowledge but also enhance their inferencing and critical reading skills.

6. Pragmatics and Contextual Language Use

Pragmatics explores how meaning is shaped by context, speaker intention, and cultural norms. In ELT, it plays a central role in developing learners' communicative competence. Language learners must understand how to interpret and produce speech acts, manage politeness, and handle indirect communication. Teaching pragmatics involves role-playing, analyzing authentic dialogues, and raising awareness of cross-cultural variation. For instance, indirect requests (e.g., "Could you possibly...?") or idiomatic expressions may not translate directly across languages and require explicit instruction.

7. Sociolinguistics and Language Variation

Sociolinguistics investigates the interaction between language and society, focusing on variation across regions, social classes, ethnic groups, and contexts. For English teachers, this field provides a valuable lens for understanding global English varieties, such as British, American, Nigerian, and Singaporean English.

Incorporating sociolinguistic content fosters students' awareness of language diversity and promotes inclusivity. Authentic materials, including news clips, interviews, and social media texts, can help expose learners to multiple registers, dialects, and styles.

8. Psycholinguistics and Language Learning

Psycholinguistics delves into how language is processed and acquired cognitively. It informs ELT by offering strategies aligned with learners' mental capacities. Understanding processes such as decoding, parsing, and articulation allows teachers to support working memory and information retrieval. Key language acquisition theories like Krashen's Input Hypothesis and Swain's Output Hypothesis, both grounded in psycholinguistic research, highlight the importance of comprehensible input and meaningful language use. Teaching practices such as scaffolding, repetition, and multimodal instruction reflect these cognitive principles.

Moreover, insights from psycholinguistics help educators adapt their methods for diverse learners, including those with specific learning difficulties or varying attention spans.

Conclusion

To conclude, linguistic theory provides a robust framework for enhancing English language teaching. Each subfield contributes unique insights that inform and improve classroom instruction, curriculum design, and learner engagement. A linguistically informed pedagogy empowers teachers to respond effectively to students' needs, promotes communicative competence, and supports inclusive, context-sensitive teaching. Strengthening the bridge between linguistic theory and ELT practice is not merely academic; it is a necessary step toward more effective and human-centered language education.

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THE ROLE OF CRITICAL READING IN ENHANCING LINGUISTIC AWARENESS AND ANALYTICAL THINKING IN EFL CONTEXTS

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Abstract

This article explores the pivotal role of critical reading in the academic development of university students, especially within the framework of foreign language learning. It highlights how critical reading involves both cognitive and metacognitive strategies: while cognitive strategies involve understanding, analyzing, and interpreting texts, metacognitive strategies help learners monitor and regulate their own reading processes through planning, questioning, and visualizing. The article also examines the linguistic, cultural, and structural challenges that students face when engaging with complex academic texts. Practical solutions are proposed, including the enrichment of academic vocabulary, polishing grammar and the implementation of exercises aimed at fostering critical thinking in both L1 and L2.

Key words: critical reading, metacognitive reading strategies, challenges, activities.

Introduction

The way a person reads information is, of course, influenced by the purpose for which they are engaging with that information. The goal behind reading largely determines the method of reading. For instance, literary texts are often read for entertainment or as a source of reflection and emotional engagement. However, in many cases, readers are required to process information that demands deeper cognitive involvement—such as comprehension, analysis, interpretation, and classification.

In such contexts, critical reading becomes an indispensable tool. Unlike surface-level reading, which focuses merely on extracting basic facts or following a narrative, critical reading involves actively questioning the text, identifying assumptions, evaluating arguments, and considering the broader implications of what is being said. It requires the reader to interact with the text on a deeper level—challenging its claims, comparing it with other sources, and relating it to their own knowledge and experience. A reader usually uses a combination of critical reading methods while reading an academic text. He/she would "scan to determine the scope and relevance of the piece, skim to pick out the key facts and the parts to explore further, then read more closely to understand in more detail and think critically about what is being written" [6].

These skills are particularly crucial in academic and professional settings, where texts are rarely neutral and often contain complex arguments, subtle biases, or underlying ideas. Critical reading allows individuals not only to understand what a text says, but also how and why it says it—and whether it should be accepted, challenged, or reinterpreted. Thus, cultivating critical reading abilities is essential for developing informed, analytical, and reflective thinkers in today's knowledge-driven society.

A student is an individual who is taking his or her first steps into the academic world. The process of engaging with science and theoretical disciplines is inseparable from the development of critical thinking and the ability to interpret reality through a critical lens. Therefore, fostering

students' capacity for critical perception of the world should be regarded as one of the most essential and urgent goals of modern education.

In today's rapidly changing and information-saturated world, students must not only acquire knowledge but also learn how to question, evaluate, and apply it in meaningful ways. Critical thinking empowers learners to distinguish between fact and opinion, recognize underlying assumptions, detect bias, and assess the credibility of sources. These skills are vital for academic success and responsible citizenship alike.

Moreover, by encouraging a critical approach to learning, educators help students become active participants in knowledge building rather than passive recipients. This transformation is fundamental to higher education, where independent inquiry, analytical reasoning, and intellectual autonomy are key outcomes. Thus, integrating critical thinking into all areas of higher education—particularly through reading, writing, and discourse analysis—should be a strategic priority at every level of the educational process. Acquiring skills of critical reading enhances students' generic skills to evaluate reality and consider a particular problem and the way of its solution not only in academic context but also in daily life [4].

Fundamental educational theories such as Bloom's Taxonomy, Critical Discourse Analysis and others provide strong theoretical grounding for the necessity of critical engagement with material in order to enhance comprehension, analysis, and, ultimately, practical application. Although Bloom's Taxonomy was revised by Anderson and Krathwohl in 2001 to better reflect contemporary understanding of cognitive processes, it continues to serve as a widely used framework within educational systems around the world. Its hierarchical model of thinking—ranging from remembering and understanding to analyzing, evaluating, and creating—offers educators a structured approach to fostering both critical thinking and creativity among learners. These competencies are particularly vital in the context of language development, where students must not only acquire linguistic structures but also learn to interpret meaning, evaluate arguments, and produce detailed responses. The revised taxonomy, with its emphasis on active, process-oriented learning, encourages learners to go beyond passive consumption of information and instead engage in the construction of knowledge [2].

Likewise, Critical Discourse Analysis, in turn, enables learners to recognize power relations, ideologies, and rhetorical strategies embedded in language—skills that are essential for becoming competent and reflective users of a second language.

Taken together, these theories highlight the urgent need to cultivate higher-order thinking skills in language education. Encouraging students to critically process and evaluate what they read not only deepens comprehension but also equips them with the tools necessary for academic success and real-world communication.

Critical reading activates both cognitive and metacognitive processes in learners. Cognitive abilities typically refer to the capacity to understand and analyze a text, identify its main ideas, and recognize cause-and-effect relationships within the content. In contrast, metacognitive abilities involve the learner's awareness of and control over their own thinking processes while working with a text. This includes the ability to select and apply appropriate reading strategies, monitor comprehension, and make adjustments when understanding breaks down.

Metacognitive reading strategies empower readers to adopt a more active and critical stance toward the text. According to Blakey and Spence (1990), metacognitive strategies involve reflecting on one's own thinking, recognizing gaps in knowledge, engaging in planning and self-monitoring, and reviewing the thought process after completing a task [1]. By consciously engaging with the material, learners can better manage the reading process and enhance their comprehension. For instance, they may visualize key information through graphic organizers, such as charts, tables, concept maps, or story maps, which help in organizing and retaining content more effectively.

These strategies not only support deeper understanding but also encourage critical thinking, allowing students to evaluate the effectiveness of their reading approaches, question textual assumptions, and make connections between ideas. By fostering both cognitive and metacognitive aspects, critical reading becomes a powerful tool for academic success.

How does critical reading contribute to a deeper understanding of language structures, discourse and pragmatics?

Engaging with a text through a critical reading lens allows learners to gain a more nuanced understanding of how language functions at multiple levels.

First and foremost, by approaching written texts analytically, readers become more aware of the mechanisms of grammatical structures and how they interact with meaning. For example, they may recognize how inversion is used for emphasis or stylistic effect, or how particular syntactic choices influence the tone and clarity of a message. This fosters a heightened sensitivity to the correlation between form and function in language.

At the lexical level, critical readers examine the choice of vocabulary and reflect on how word selection shapes meaning, tone and reader's perception. This not only enhances lexical awareness but also introduces learners to the fine details of connotation, author's voice and stylistic variation.

From a discourse perspective, critical reading helps learners identify and interpret text types, genres and stylistic features. It also trains them to recognize and understand figurative language such as metaphors, similes, irony, and rhetorical devices—elements that are often crucial for full comprehension but easily overlooked in surface-level reading.

In terms of pragmatics, critical reading enables learners to grasp the intended meaning, communicative goals and persuasive strategies used by the author. They learn to ask: *What is the author trying to achieve? Who is the target audience? How might different readers interpret this message?* Through this process, students become more skilled at detecting implied meanings and contextual influences that affect interpretation. Pragmatics, in all its diversity, is a vital component of communication. Its study involves understanding not only the literal meaning of utterances but also their communicative intent and effect on the audience [5]. Critical reading, therefore, acts as a bridge between linguistic form and communicative function, fostering interpretive precision and linguistic competence.

However, EFL students frequently encounter a range of challenges when developing critical reading skills. This is hardly surprising, as academic texts are often dense with specialized terminology, lengthy and complex sentence structures, discourse-semantic patterns, and grammatically intricate constructions.

Texts are not simply collections of unrelated words; rather, they represent layered meanings—from the macro level of the entire text, to its sections, paragraphs, and down to individual sentences. Each paragraph serves as a semantic unit, marking a distinct stage of meaning, while each sentence is composed of clusters of words that carry meaning-bearing fragments [3].

One of the most common obstacles is an insufficient vocabulary in the target language, which makes it difficult for students to grasp nuanced meanings or infer information from context. Furthermore, critical thinking skills—such as analysis, synthesis, and evaluation—may not be fully developed even in the learners' native language. This lack of foundational cognitive skills can complicate their application in a foreign language context.

Another barrier lies in the cultural knowledge and implicit references embedded in texts. Without deep understanding of the cultural framework embedded in a text, students may struggle to interpret the author's intent or evaluate the underlying assumptions and values critically.

Additionally, for unexperienced readers, the length and density of academic texts can pose significant difficulties. Long texts often demand sustained concentration, mental stamina, and

advanced reading strategies. Without these, learners may experience cognitive overload, which negatively impacts the efficiency and depth of critical reading.

To overcome the aforementioned difficulties, it is advisable to take a number of targeted steps. First and foremost, students should actively work on expanding their vocabulary, with particular emphasis on academic vocabulary, which frequently appears in scholarly texts but is less common in everyday speech. Mastery of such vocabulary allows learners to engage more confidently and competently with academic materials.

In addition, a deeper understanding of grammar and syntax in the target language is essential. Students must become familiar with complex sentence structures and stylistic devices often employed in academic discourse, such as nominalization, passive constructions, and cohesive devices. This helps them not only to comprehend the surface meaning but also to analyze how language is used to convey arguments and perspectives.

Moreover, the development of critical thinking skills should begin in the students' native language and then be transferred to the foreign language. This approach allows learners to first improve the necessary reasoning strategies before applying them in a more cognitively demanding context.

A variety of exercises and activities can be employed to nurture critical thinking and critical reading. These include:

- Identifying the author's purpose and perspective, helping students learn to distinguish between facts, opinions, and bias;
- Argument mapping, where students visually represent the structure of an argument to identify claims, evidence, and counterarguments;
- Text annotation, encouraging learners to highlight key ideas, raise questions, and make comments directly on the text;
- Socratic questioning or guided discussion, which helps deepen interpretation and encourages multiple perspectives;
- Comparative text analysis, where students analyze two or more texts on the same topic but from different viewpoints;
- Critical summaries, requiring students not just to retell but to evaluate and reflect on the content;
- Reflective writing, where learners express how a text influenced their thoughts or challenged prior assumptions.

By incorporating these strategies and exercises, educators can create a more supportive and intellectually stimulating environment that fosters both linguistic competence and critical literacy.

Conclusion

In an era defined by an overwhelming flow of information and increasingly complex communication demands, critical reading emerges as a foundational skill for academic and intellectual development. It empowers learners to move beyond passive absorption of information and become active, reflective participants in the construction of knowledge. By training students to analyze language and evaluate arguments, educators not only enhance their linguistic competence but also cultivate the critical thinking skills essential for lifelong learning. Despite the challenges faced by EFL learners—ranging from vocabulary gaps to cultural misunderstandings—these obstacles can be effectively addressed through systematic instruction and thoughtfully designed activities. The integration of critical reading strategies into language education is not merely beneficial; it is necessary for preparing students to navigate both academic contexts and the broader social world with confidence and insight.

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ОРТА МЕКТЕПТЕ ЭЛЕКТР ЖӘНЕ МАГНЕТИЗМ БӨЛІМІН ОҚЫТУДА ЗАМАНАУИ ТЕХНОЛОГИЯЛАРДЫ ҚОЛДАНУ ӘДІСТЕМЕСІ

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Аңдатпа. Мақалада орта мектеп физика курсындағы «Электр және магнетизм» бөлімін оқытуда заманауи технологияларды тиімді қолдану жолдары қарастырылады. Зерттеу барысында интерактивті тақта, виртуалды зертханалар, симуляциялар (PhET, Crocodile Physics), сандық платформалар (Google Classroom, Kahoot, Quizizz), сондай-ақ STEM және STEAM элементтері сияқты заманауи білім беру құралдарының мүмкіндіктері талданды. Сонымен қатар оқушылардың пәнге қызығушылығын арттыру, теориялық білімді тәжірибе арқылы меңгеру, және шығармашылық ойлау қабілеттерін дамытуға бағытталған педагогикалық тәсілдер ұсынылады. Жұмыс жаңартылған білім мазмұны мен критериалды бағалау жүйесі талаптарына сәйкес келеді.

Кілт сөздер: электр, магнетизм, заманауи технологиялар, интерактивті оқыту, цифрлық білім беру, виртуалды зертхана, STEM.

МЕТОДИКА ПРИМЕНЕНИЯ СОВРЕМЕННЫХ ТЕХНОЛОГИЙ ПРИ ОБУЧЕНИИ РАЗДЕЛА ЭЛЕКТРИЧЕСТВА И МАГНЕТИЗМА В СРЕДНЕЙ ШКОЛЕ

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Аннотация. В статье рассматриваются способы эффективного использования современных технологий при обучении разделу «Электричество и магнетизм» в курсе физики средней школы. В ходе исследования были проанализированы возможности современных образовательных инструментов, таких как интерактивная доска, виртуальные лаборатории, симуляции (PhET, Crocodile Physics), цифровые платформы (Google Classroom, Kahoot, Quizizz), а также элементы STEM и STEAM. Также предлагаются педагогические подходы, направленные на повышение интереса учащихся к предмету, усвоение теоретических знаний на практике, и развитие навыков творческого мышления. Работа соответствует требованиям обновленного содержания образования и системы критериального оценивания.

Ключевые слова: электричество, магнетизм, современные технологии, интерактивное обучение, цифровое образование, виртуальная лаборатория, STEM.

Білім беруде қазіргі таңда орта мектеп физика курсындағы «Электр және магнетизм» бөлімін оқытуда заманауи технологияларды қолданудың әдістемелік негіздері қарастырылады. Ақпараттық-коммуникациялық технологияларды, интерактивті құралдарды және виртуалды зертханаларды тиімді пайдалану оқушылардың пәнге деген қызығушылығын арттырып, оқу материалын терең меңгеруіне ықпал етеді. Мақалада нақты технологиялар мен платформалар мысалында оқыту әдістері сипатталып, практикалық ұсыныстар беріледі.

Қазіргі білім беру жүйесінде оқыту процесін цифрландыру – білім сапасын арттырудың маңызды жолдарының бірі. Физика пәнінің күрделі тарауларының бірі – электр және магнетизм [1]. Бұл тақырыптарды түсіндіруде дәстүрлі әдістермен қатар заманауи технологияларды қолдану оқушылардың танымдық қызығушылығын арттырып, оқу процесін интерактивті етеді. Оқушылардың ғылым мен техниканы түсінуіне мүмкіндік беретін заманауи әдіс-тәсілдер мен технологиялар кеңінен қолданылуда. Әсіресе физика пәнін нақтылыққа бағытталғандықтан, нақты тәжірибелер мен көрнекілікке негізделген оқыту ерекше маңызға ие. Электр және магнетизм бөлімінде теорияны түсіндірумен қатар, оны практикалық тұрғыдан сезіну оқушылардың пәнге деген қызығушылығын арттырудың негізгі жолы болып табылады. Бұл үдерісте заманауи цифрлық технологиялар мен

интерактивті құралдардың маңызы зор. Осы орайда, сандық симуляциялар мен виртуалды зертханалар тиімді және витруалды шындық түрлерін, АКТ құралдарын ұтымды қолдану қажет, сонымен қатар оқушылардың функционалдық сауаттылығын арттыруға да болады [2]. Заманауи технологияларды қолдану арқылы білім алушылардың қызығушылығы артады, тәжірибе жасау мүмкіндігі көбейеді, оқушы зерттеу дағдысын қалыптастырады, жеке және топпен интерактивті оқу ортасы құрылады (1-кестені қараңыз).

1-кесте. Электр және магнетизм бөлімінде заманауи технологияларды қолдану кестесі

№	Технология / Құрал түрі	Қолдану әдісі	Артықшылықтары	Қолдану мысалы
1	**PhET симуляциялары**	Электр тізбектерін, Кулон заңын визуалды түрде түсіндіру	Интерактивтілік, қашықтан оқу мүмкіндігі	«Ом заңы» симуляциясын пайдалану
2	**Интерактивті тақта**	Электр өрісі мен потенциалын сызбалар арқылы көрсету	Көрнекілік, нақты түсіндіру	Электр өрісі бағытын көрсету
3	**Виртуалды зертханалар**	Тәжірибе жасау мүмкіндігін қамтамасыз ету	Қауіпсіздік, қымбат құрал-жабдық қажет емес	«Электроскоп жұмысы» виртуалды тәжірибесі
4	**Мобильді қосымшалар (Kahoot, Quizizz)**	Білімді бекіту, бақылау тесттерін жүргізу	Оқушыларды ынталандыру, тез кері байланыс	Электр тізбегі бойынша тест өткізу
5	**STEM платформалар (Arduino)**	Жобалық жұмыс жасау, электр тізбегін құрастыру	Практикалық дағдыны дамыту, шығармашылық	LED шамды қосу жобасы
6	**YouTube видеосабақтар**	Теориялық материалды визуал түрде ұсыну	Қолжетімділік, түрлі стильдегі түсіндіру	«Магнит өрісі» тақырыбындағы анимация
7	**Презентациялар (PowerPoint, Prezi)**	Сабақ құрылымын визуалды түрде жеткізу	Ақпаратты құрылымды беру, назар аударту	Электр зарядтары туралы слайд

Электр және магнетизм бөлімі күрделі болғанымен, заманауи технологиялардың көмегімен бұл тақырыпты оқушыларға жеңіл, қызықты әрі өмірмен байланыстыра отырып түсіндіруге болады. Мұғалім үшін ең бастысы – дәстүрлі әдістер мен цифрлық құралдарды тиімді үйлестіріп, оқушыны белсенді білім алушы деңгейіне көтеру. XXI ғасыр оқушысы тек білім алушы ғана емес, ол – ізденуші, зерттеуші, жаңашыл тұлға**,** ал мұғалім – соған бағыт беруші [3]. Осы орайда, оқушыларға практикалық тапсырмалар оқушыны тақырыпты терең түсінуге мүмкіндік береді. Мысалы, электр тізбегін дұрыс құрастыру дағдыларын қалыптастыру, ток күші, кернеу және кедергі арасындағы байланысты анықтау, сандық симуляцияны қолдана отырып зерттеу жүргізу мақсатында «Электр тізбегін құрастыру және ток күшін зерттеу» (PhET симуляциясы негізінде) тақырыбында практика ұсынуға болады. Құрал-жабдықтарға компьютер немесе планшет, PhET симуляциясы https://phet.colorado.edu/en/simulation/circuit-construction-kit-dc ұсыну [4].

Тәжірибе барысында зерттеу сұрақтарын беріп, оқушының тақырыпты терең талдағанын қарауға болады. Сұрақтар аясы бастапқы ток күші, резистор қосылғаннан кейін

ток күші өзгерісі аясында беріледі. Қорытынды жазуда электр тізбегін құрастыру кезіндегі тәжірибені сипаттау ұсынылады. Заманауи технологияларды жиі қолданудың гисторграммасынан нақты деректерді көрсеткенде, біз белгілі бір әдістердің қолданылу деңгейін салыстырып көре аламыз. Мысалы, интерактивті тақтаның немесе PhET симуляцияларының қолдану жиілігі әдетте жоғары болып келеді, ал STEM құрылғылары немесе мобильді қосымшалардың қолдану деңгейі салыстырмалы түрде төмен болуы мүмкін. Интерактивті тақталар қазіргі білім беру жүйесінде маңызды рөл атқарады [5]. Бұл технологияны қолдану оқушылардың пәнге деген қызығушылығын арттырып, материалды тиімді түсінуге мүмкіндік береді. 2-кестеде бұл құралдың қолдану жиілігі жоғары көрсеткішке ие, себебі оқушыларға визуалды түрде түсіндіру, презентациялар мен сызбаларды көрсету, сұрақ-жауап форматында оқыту өте тиімді. Бұл әдіс оқушылардың материалды тереңірек меңгеруіне көмектеседі.

2- кесте. Заманауи құралдардың қолдану жиілігі

Технология	**Қолдану жиілігі (%)**
Интерактивті тақта	90%
PhET симуляциясы	75%
Виртуалды зертханалар	60%
Мобильді қосымшалар (Kahoot, Wordwall)	50%
STEM құрылғылар (Arduino)	30%

2-кестедегі мәліметтерге сәйкес, интерактивті тақтаның қолданылу жиілігі ең жоғары көрсеткішке (90%) ие. Бұл құралдың тиімділігі оқушылардың тақырыпты **визуалды түрде қабылдауына** мүмкіндік береді. Ол **презентациялар мен графикалық материалдарды** көрсету, сондай-ақ **сұрақ-жауап форматындағы** интерактивті оқыту әдістерін қолдану үшін аса қолайлы. Осы әдістердің арқасында оқушылардың оқу материалын тереңірек меңгеру деңгейі артады, бұл оқу процесінің жалпы тиімділігіне оң әсер етеді.

Кестеде келтірілген басқа да заманауи білім беру құралдарының қолданылу жиілігі әр түрлі мақсаттарға байланысты болады. Мысалы, **PhET симуляциялары** (75%) мен **виртуалды зертханалар** (60%) жаратылыстану пәндерін оқытуда, әсіресе физика, химия және биология сабақтарында, теориялық білімді тәжірибелік тұрғыда бекіту үшін тиімді. Бұл құралдар оқушыларға қауіпсіз ортада тәжірибелер жасауға және абстрактілі ұғымдарды визуалды түрде түсінуге мүмкіндік береді.

Мобильді қосымшалар (Kahoot, Wordwall) (50%) оқыту процесіне ойын элементтерін енгізу арқылы оқушылардың қызығушылығын арттыруға бағытталған. Бұл әдіс білімді тексеру мен қайталау үшін тиімді, сондай-ақ сыныпта бәсекелестік орта қалыптастырады.

STEM құрылғылар (Arduino) (30%) қолданылу жиілігі төмендеу болса да, олар **инженерлік ойлау** мен **проблемаларды шешу дағдыларын** дамытуға үлкен үлес қосады. Мұндай құралдар бағдарламалау, робототехника және электроника сияқты пәндерде нақты жобаларды жасау арқылы теориялық білімді практикалық іс-әрекетпен байланыстыруға көмектеседі. Осылайша, бұл құралдардың әрқайсысы білім берудің белгілі бір саласында маңызды рөл атқарады.

Енді заманауи технологияларға негізделген оқу тапсырмаларының ғылыми-әдістемелік сипаттамасын қарастырайық. Қазіргі білім беру жүйесінде оқушылардың танымдық қызығушылығын арттыру және оқу материалының тиімді меңгерілуін қамтамасыз ету үшін заманауи технологиялар белсенді түрде қолданылады. Төменде заманауи технологияларға негізделген бірнеше оқу тапсырмаларының ғылыми тұрғыдан сипаттамасы берілген.

Wordwall платформасы: Тест тапсырмасы

Әдістемелік сипаттамасы: Wordwall – интерактивті тапсырмаларды жасауға арналған әмбебап онлайн платформа. Тест тапсырмалары оқушылардың білім деңгейін жедел тексеруге және бекітуге бағытталған. Әр сұраққа бірнеше жауап нұсқасы ұсынылып, оқушы дұрыс жауапты таңдайды. Дұрыс жауап берілген жағдайда, жүйе бірден кері байланыс береді.

Ғылыми негіздемесі: Бұл әдіс **бихевиоризм** және **когнитивизм** теорияларына негізделген. Оқушының дұрыс жауап беруі – оң кері байланыс алу арқылы бекітілетін мінез-құлық. Бұл **Скиннердің оперантты шарттану теориясымен** тығыз байланысты. Сонымен қатар, тест оқушының қысқа мерзімді жадынан ақпаратты тез іздеп табуына және қайта жаңғыртуына көмектеседі, бұл **когнитивті дағдыларды** дамытады. Интерактивті формат ойын элементтерін қосу арқылы мотивацияны арттырады [6].

Wordwall платформасы: Сәйкестендіру

Әдістемелік сипаттамасы: Сәйкестендіру тапсырмасы екі немесе одан да көп элементтердің арасындағы логикалық байланысты анықтауға арналған. Мысалы, термин мен оның анықтамасын, тарихи оқиға мен оның жылын, сурет пен оның атауын сәйкестендіру. Оқушы экрандағы элементтерді бір-біріне сәйкестендіру арқылы тапсырманы орындайды.

Ғылыми негіздемесі: Бұл тапсырма **ассоциативті оқыту** және **категоризациялау** қағидаттарына сүйенеді. Оқушылар жаңа ақпаратты бұрыннан бар білімдерімен байланыстыра отырып меңгереді. Бұл **когнитивті схемаларды** қалыптастыруға ықпал етеді. Сәйкестендіру арқылы оқушылар мәліметтерді жеке-жеке есте сақтаудан гөрі, олардың арасындағы құрылымдық байланыстарды түсінуге тырысады. Бұл әдіс ақпаратты ұзақ мерзімді жадыда сақтауға қолайлы [6].

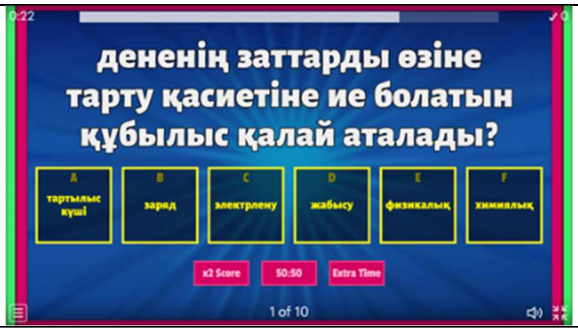
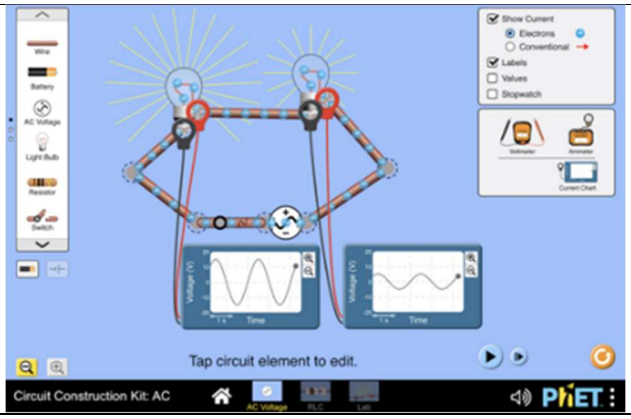
PhET Interactive Simulations платформасы: Тізбектей жалғауда кернеудің таралуын зерттеу (Зертханалық жұмыс)

Әдістемелік сипаттамасы: PhET — Колорадо университетінің интерактивті симуляциялар жиынтығы. Оқушылар бұл платформада виртуалды зертханалық жұмыстар жүргізеді. «Тізбектей жалғауда кернеудің таралуын зерттеу» тапсырмасында оқушылар виртуалды электр тізбегін құрастырып, құралдардың (амперметр, вольтметр) көрсеткіштерін бақылайды. Симуляция арқылы олар тізбектей жалғанған өткізгіштердегі жалпы кернеудің жеке бөліктердегі кернеулердің қосындысына тең болатынын тәжірибе жүзінде көреді.

Ғылыми негіздемесі: Бұл тапсырма **конструктивизм** педагогикалық теориясына негізделген. Конструктивизм теориясы бойынша, оқушы білімді дайын күйінде алмай, оны өзінің тәжірибесі арқылы құрастырады. PhET симуляциясы оқушыларға **эмпирикалық білім** алуға мүмкіндік береді. Олар гипотеза ұсынып, тәжірибе жүргізіп, нәтижелерін талдайды. Бұл үдеріс **ғылыми ойлау** дағдыларын қалыптастырады. Виртуалды зертхана нақты жабдықтармен жұмыс істеуге қарағанда қауіпсіз, әрі зерттеу параметрлерін тез өзгертіп, әртүрлі жағдайларды қарастыруға мүмкіндік береді. Бұл оқушының **сыни ойлауы** мен **проблеманы шешу** қабілетін дамытады [7].

Бұл заманауи технологиялар оқу үдерісін тек қызықты етіп қана қоймай, оқушылардың білімді терең әрі тиімді меңгеруіне, сондай-ақ ғылыми ойлау мен практикалық дағдыларын дамытуға ықпал етеді. Бұл әдістер педагогикалық және психологиялық ғылымдардың соңғы жетістіктеріне негізделген. 3-кестеде заманауи технологияларға негізделген бірнеше тапсырмалар көрсетілген.

3-кесте. Заманауи технологияларға негізделген тапсырмалар

Платформа	**Тапсырма мысалы**
Wordwall (Тест тапсырмасы)	
Wordwall (Сәйкестендіру)	
Phet.colorado.edu (Зертханалық жұмыс: Тізбектей жалғауда кернеудің таралуын зерттеу)	

Физика пәніндегі көрнекі тәжірибелердің негізгі ұтымды тұсы – физикалық құбылыстарды кең ауқымда бейнелеу және оларды жан-жақты талдауға жағдай жасау. Көз жеткізерлік шындық – ақпараттың басым бөлігі адамға көру арқылы қабылданады. Көрнекі тәжірибелер арқылы оқушылар процестерді өз көздерімен көрмейінше, физикалық құбылыстардың түпкі мағынасын жете түсіне алмайды. Сондықтан сабақ үстінде тақырыпқа сай бейнелі құралдарды, демонстрациялық тәжірибелерді тиімді пайдалану қажет. Осыған байланысты тек табиғи жолмен жүргізілетін көрнекі тәжірибелермен шектелмей, қазіргі заман талаптарына сай виртуалды зертханалық жұмыстарды да физиканы оқыту үдерісінде қолданудың мәні зор.

Эксперименттік кезең. Ұсынылған әдістеменің мақсатқа сәйкестігін және ғылыми болжамның нақтылығын дәлелдеу мақсатында педагогикалық эксперимент жүргізілді. Педагогикалық экспериментке Алматы қаласындағы №13 мектеп-гимназия базасында 8 «А» және «Б» сыныптары бойынша 28 оқушы қатысты. Эксперимент ұзақтығы екі апта (тұрақты электр тогы тарауы бойынша)

Эксперимент мақсаты: Электр және магнетизм бөлімін оқытуда заманауи технологияларды (интерактивті тақта, PhET симуляциялары, онлайн платформа т.б.) қолданудың оқушылардың оқу жетістігіне әсерін анықтау.

Эксперименттік сынып (Сынып 8 «А»): Бұл сынып электр және магнетизмді оқытуда заманауи технологиялар қолданылған сынып.

Бақылау сыныбы (Сынып 8 «Б»): Бұл сынып дәстүрлі әдіспен (мысалы, оқулықтар мен мұғалімнің түсіндірмесі арқылы) оқытылған.

Бағалау әдісі. Эксперимент соңында екі топқа бірдей тест тапсырмасы берілді (20 сұрақ, оның ішінде теория мен есептер). Сонымен қатар оқушылардың сабаққа қатысу белсенділігі, қызығушылығы, рефлексия парақтары ескерілді. Төмендегі 4-кестеде сыныптар туралы мәліметтер көрсетілген.

4-кесте.Сыныптар туралы мәлімет

Топ	**Оқушы саны (n)**	**Орташа балл (M)**	**Стандартты ауытқу (s)**
Эксперименттік, 8 «А»	$n_1 = 25$	$M_1 = 16{,}4$	$S_1 = 2{,}1$
Бақылау, 8 «Б»	$n_2 = 23$	$M_2 = 14{,}2$	$S_2 = 2{,}4$

Ұсынылған әдістеменің мақсатқа сәйкестігін және ғылыми болжамның нақтылығын дәлелдеу үшін өлшеу метрлік шкаладағы тәуелсіз айнымалылар үшін құбылыстың немесе үдерістің әр түрлі екі топтағы күйлерінің арасындағы айырмашылықтың сенімділігін бағалау үшін қолданылатын Стьюденттің t-критерийі пайдаланылды [8].

Осы зерттеуде келесі статистикалық болжамдар тексерілді:

H0: «Бақылау тобы мен эксперименттік топ оқушыларының эксперимент соңындағы білім деңгейлері арасында айырмашылы жоқ».

H1: «Бақылау тобы мен эксперименттік топ оқушыларының эксперимент соңындағы білім деңгейлері арасында мәнд айырмашылық бар».

Осы көрсетілген болжамдарды тексеру үшін критерийдің $t_{эмп}$ мәнін есептейміз.

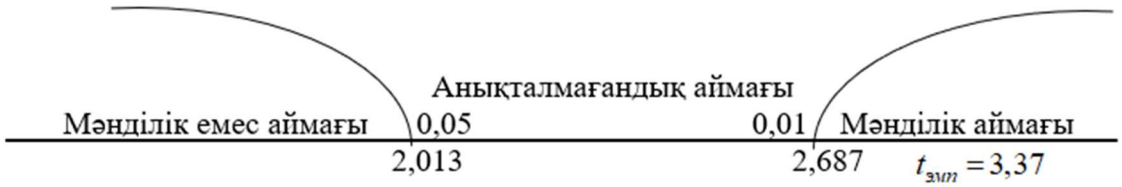
Есептеулер нәтижесінде $t_{эмп} = 3{,}37$. Еркіндік дәрежесі $df = 46$ тең екені белгілі болды.

Кесте бойынша $df = 46$ үшін Стьюденттің t - критерийінің кризистік мәндерін табамыз: $p \le 0{,}05$ үшін $t_{1кр} = 2{,}013$ және $p \le 0{,}01$ үшін $t_{2кр} = 2{,}687$.

Кризистік мәндерді келесі түрде жазамыз:

$$t_{кр} = \begin{cases} 2{,}013, \text{егер } p \le 0{,}05 \\ 2{,}687, \text{егер } p \le 0{,}01 \end{cases}$$

Мәнділік осіне 2,013 және 2,687 мәндерін орналастырып, мәнділік аймақтарын анықтаймыз.



1-сурет. 8-сынып бойынша $t_{эмп}$ эмпирикалық мәні

1-суреттен көрініп тұрғандай, статистикалық болжамның H1 тұжырымдамасын қабылдаймыз: $t_{эмп} = 3{,}37$ саны мәнділік аймағында жатыр, сондықтан алтернативті болжамды қабылдаймыз, яғни ұсынылған әдістеме өз мақсатына жетті деп есептейміз.

Эксперименттік топта заманауи технологияларды қолдану нәтижесінде оқушылардың пәнге қызығушылығы мен білім сапасы айтарлықтай артқаны байқалды. Бұл

технологиялар тақырыпты визуалды түрде жақсы түсінуге, өздігінен білім алуға және практикалық дағдыларды дамытуға көмектеседі. Сондықтан электр және магнетизм бөлімін оқытуда заманауи құралдарды мақсатты түрде пайдалану – тиімді әдістемелік бағыттардың бірі болып табылады.

Электр және магнетизм бөлімін оқытуда заманауи технологияларды қолдану оқушылардың пәнге деген қызығушылығын арттырып, материалды терең әрі жүйелі меңгеруге мүмкіндік береді. Мұғалім үшін басты міндет – осы технологияларды дұрыс таңдап, сабақ құрылымына тиімді енгізу. Заманауи технологияларды оқу процесіне интеграциялау білім беру жүйесінің сапасын арттыруға зор әсерін тигізеді [9]. 2-кестедегі мәліметтерге сүйенсек, оқытудың әр түрлі технологияларының жиі қолданылуы оқушылардың пәнге деген қызығушылығын, оқу материалын меңгеру деңгейін және жалпы білім сапасын арттырады. Интерактивті тақталар, PhET симуляциялары, мобильді қосымшалар және STEM құралдары оқушыларды белсенді түрде оқытуға мүмкіндік береді, оларды теория мен практиканы байланыстырып, жаңа білімді қолдануға итермелейді. Әсіресе, интерактивті технологиялар оқыту процесін қызықты әрі ұтымды етеді, ал мобильді қосымшалар мен симуляциялар оқушыларға жылдам кері байланыс беру арқылы олардың оқу барысындағы қиындықтарын жеңуге көмектеседі. Сонымен қатар, STEM құрылғылары мен виртуалды зертханалар оқушыларға нақты өмірде қолданылатын дағдыларды меңгеруге мүмкіндік береді [10].

Қорыта келгенде, заманауи технологияларды жиі қолдану білім алудың тиімділігін арттырып қана қоймай, оқу процесін қызықты, тартымды және динамикалы етеді. Бұл технологиялардың жүйелі түрде қолданылуы оқушылардың білімін тереңдетіп, олардың шығармашылық қабілеттерін дамытуға да үлкен үлес қосады. Білім беру жүйесін цифрландыру, жаңа технологияларды қолдану – бүгінгі күннің басты қажеттілігі болып табылады және болашақта бұл бағыттың маңыздылығы арта түседі.

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ӘОК 373.5:53:371.38

ОРТА МЕКТЕПТЕ ФИЗИКАНЫ ОҚЫТУДА ОЙЫН ТЕХНОЛОГИЯЛАРЫН ҚОЛДАНУДЫҢ ӘДІСТЕМЕЛІК НЕГІЗДЕРІ

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Аңдатпа. Мақалада физика пәнін оқыту үдерісіне ойын технологияларын енгізудің тиімділігі сипатталады. Қазіргі білім беру жүйесінде оқушылардың пәнге деген қызығушылығын арттыру, олардың белсенділігін күшейту және білім сапасын жоғарылату басты міндеттердің бірі болып табылады. Осы мақсатта сабақ барысында ойын элементтерін қолдану арқылы оқушылардың танымдық белсенділігі мен оқу мотивациясы артады. Ойын технологиялары оқытудың дәстүрлі формаларын түрлендіріп, оқушыларды оқу процесіне белсенді түрде қатыстыруға мүмкіндік береді. Физиканың абстрактілі ұғымдарын түсіндіру барысында қолданылатын ойын тәсілдері – ұпай жинау, деңгейлік тапсырмалар, жарыс элементтері, онлайн викториналар – оқушының логикалық ойлауын, топпен жұмыс істеу дағдыларын және пәнге деген қызығушылығын дамытады. Сабақ құрылымында әр кезеңге сәйкес ойын элементтерін енгізу арқылы материалды меңгеру сапасы жақсарады. Эксперименттік зерттеу Алматы қаласындағы мамандандырылған білім беру ұйымында 8-сынып оқушылары арасында жүргізілді. Зерттеуге қатысқан топтарда ойын технологиялары қолданылған жағдайда оқушылардың оқу жетістігі мен белсенділігі жоғары нәтиже көрсетті. Статистикалық өңдеу нәтижесінде әдістің тиімділігін дәлелдеді.

Кілт сөздер: ойын технологиялары, физика, оқу мотивациясы, оқыту әдістері, интерактивті әдістер, танымдық қызығушылық.

МЕТОДИЧЕСКИЕ ОСНОВЫ ИСПОЛЬЗОВАНИЯ ИГРОВЫХ ТЕХНОЛОГИЙ В ПРЕПОДАВАНИИ ФИЗИКИ В СРЕДНЕЙ ШКОЛЕ

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Аннотация. В статье описывается эффективность внедрения игровых технологий в процесс преподавания физики. В современной системе образования одной из главных задач является повышение интереса учащихся к предмету, активизация их познавательной деятельности и повышение качества обучения. С этой целью использование игровых элементов на уроках способствует росту учебной мотивации и познавательной активности школьников. Игровые технологии трансформируют традиционные формы обучения и вовлекают учащихся в активное участие в образовательном процессе. Применяемые при объяснении абстрактных понятий физики игровые приемы – накопление баллов, уровневые задания, элементы соревнований, онлайн-викторины – развивают логическое мышление, навыки работы в команде и интерес к предмету. Введение игровых элементов на каждом этапе урока способствует более качественному усвоению материала. Экспериментальное исследование проводилось среди учеников 8 класса специализированного образовательного учреждения города Алматы. В группах, где применялись игровые технологии, были зафиксированы более высокие показатели учебных достижений и активности. Результаты статистической обработки подтвердили эффективность данного метода.

Ключевые слова: игровые технологии, физика, учебная мотивация, методы обучения, интерактивные методы, познавательный интерес.

METHODOLOGICAL FOUNDATIONS FOR THE USE OF GAME-BASED TECHNOLOGIES IN TEACHING PHYSICS IN SECONDARY SCHOOL

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Abstract. The article describes the effectiveness of integrating game-based technologies into the process of teaching physics. In the modern education system, increasing students' interest in the subject, enhancing their engagement, and improving the quality of education are among the key priorities. The use of game elements in lessons boosts students' cognitive activity and learning motivation. Game-based technologies help transform traditional teaching approaches and encourage active participation in the learning process. When explaining abstract physics concepts, techniques such as point scoring, level-based tasks, competition elements, and online quizzes develop students' logical thinking, teamwork skills, and interest in the subject. Incorporating game elements at each stage of the lesson improves content retention and understanding. An experimental study was conducted among 8th-grade students at a specialized educational institution in Almaty. The groups where game technologies were applied showed higher levels of academic achievement and engagement. Statistical analysis confirmed the effectiveness of the method.

Keywords: game-based technologies, physics, learning motivation, teaching methods, interactive methods, cognitive interest.

Кіріспе

Қазақстан Республикасының Президенті Қасым-Жомарт Тоқаевтың бастамасымен әзірленген «Білімді ұлт» сапалы білім беру» ұлттық жобасында еңбек нарығының талаптарына сай мамандарды даярлау, соның ішінде мектеп оқушыларының білім сапасын арттыру басты мақсат ретінде қойылған. Бұл өз кезегінде, мектепте сапалы білім берудің жаңа әдістері мен тәсілдерін енгізуді талап етеді [1]. Физика пәні оқушыларға табиғат құбылыстарын түсіндіретін маңызды білім саласы болғанымен, оны оқыту кезінде теориялық материалдың күрделілігі, оқушылардың пәнге деген қызығушылығының төмендеуі және сабаққа белсенді қатысуының жеткіліксіздігі жиі кездесетін қиындықтарға айналады. Осы мәселелерді шешу үшін педагогикалық үрдіске заманауи технологияларды, оның ішінде ойын технологияларын енгізу маңызды рөл атқарады.

Ойын элементтерін оқыту процесіне енгізу оқушылардың белсенді қатысуына ықпал етеді. Дәстүрлі оқыту әдісінде мұғалімнің рөлі басым болса, геймификация кезінде оқушы белсенді түрде тапсырмаларды орындап, топпен жұмыс істейді. Бұл оқушылардың тек

тыңдаушы емес, үдерістің белсенді қатысушысы болуына мүмкіндік береді. Оқушыларды тек тапсырмаларды орындауға ғана емес, шешім қабылдауға және олардың логикалық ойлау қабілеттерін дамытады.

Ойын технологиялары мен дәстүрлі оқыту әдістері арасында бірнеше айтарлықтай айырмашылықтар бар. Дәстүрлі әдіс көбінесе біржақты және мұғалімнің берген тапсырмасын орындауға бағытталған. Ал ойын технологияларында оқушыға ойын элементтері мен деңгейлер арқылы нақты мақсаттар қойылады, мұнда ол өз жетістіктерін бақылай алады және жаңа деңгейге көтерілу үшін өз білімі мен дағдыларын қолдануы қажет болады. Бұл оқушыларды белсенді етуге және сабаққа деген қызығушылығын арттыруға ықпал етеді. Сонымен қатар, дәстүрлі оқыту әдісінде оқушылар көбінесе тек тыңдаушы болып қалады, ал ойын технологияларында олар өздерінің ойларын айтуға, топтық жұмыстарға қатысуға және әр түрлі тапсырмаларды шешуге ынталандырылады.

Токжигитова А.Н. өз диссертациясында студенттердің білім алу белсенділігін арттыру мақсатында арнайы әзірленген ойын технология элементтерін (марапат жүйесі, деңгейлер, ойын сценарийлері) қолданудың әдістемелік нұсқауларын ұсынады [2]. Ал Ангешанова Г.Г, Танбетова Н.К. зерттеу жұмыстарында оқушылардың танымдық белсенділігін арттыру және ақыл-ойын дамыту үшін ойын элементтерін оқу процесіне қосу маңызды екені айтылған. Сондай-ақ, ойын технологиясын тиімді жүзеге асыру үшін мұқият жоспарлау қажет екендігі атап өтілген. Мұғалімдер ойынның көмегімен оқыту әдісін қолдана отырып, оқушылардың өздігінен білім алуға деген ынтасын оята алады. Ойын технологиясы дәстүрлі оқыту әдістерімен үйлесімді болғанда, оқушылардың білім деңгейін арттыру үшін ең қолайлы әдіс ретінде қарастырылады [3]. Хамид С.А. және әріптестері өз зерттеуінде физика пәнін оқытуда PhET симуляцияларын ойын түріндегі оқу құралы ретінде қолданудың тиімділігін тәжірибелік түрде зерттеген. Авторлар студенттердің танымдық белсенділігін арттыруда PhET симуляцияларының маңызы зор екенін көрсетеді. Зерттеу барысында PhET қолданылған топтағы студенттердің оқу жетістіктері мен пәнге деген қызығушылығы дәстүрлі әдіспен оқытылған топпен салыстырғанда анағұрлым жоғары болғаны анықталды. Авторлар квазитәжірибелік әдісін (quasi-experimental method) қолданған. Зерттеу барысында алдын ала тест (pre-test) және кейінгі тест (post-test) жүргізіліп, екі топтың нәтижелері статистикалық тәсілдермен салыстырылған (t-тест) [4]. Бұл әдіс PhET симуляциясының тиімділігін нақты салыстыруға мүмкіндік береді, алайда зерттеу толық рандомизацияланбағандықтан, оны «quasi» деп атайды. Ал Бегмурадов Ш. өз мақаласында ғылымды оқытуда білім беру технологияларын, соның ішінде ойын элементтерін қолданудың теориялық негіздері қарастырылады. Автор білім алушылардың ғылыми құбылыстарды түсінуі мен визуализациясын жеңілдету мақсатында цифрлық құралдарды, симуляцияларды және интерактивті платформаларды оқу процесіне енгізу қажеттігін атап өтеді. Автор білім беру саласындағы заманауи технологияларды, соның ішінде ойын технологияларын, интерактивті оқыту құралдары, сандық ресурстарды қолданудың педагогикалық және психологиялық аспектілерін ғылыми әдебиеттерге сүйене отырып талдаған [5].

Сонымен, геймификацияланған оқытудың бірқатар артықшылықтары бар. *Біріншіден,* оқу үрдісіне ұпайлар мен белгішелер тәрізді ойын элементтерін енгізу оқытуды қызықты етіп жасаудың тиімді жолы ретінде дәлелденді. Ойын механизмдері оқушыларға олардың жетістіктері мен жетістіктерінің көрінетін белгілерін ұсына отырып, оқу марапаттары ретінде әрекет етеді. Мұндай тәсіл оқу материалын жақсы меңгеруге ғана емес, сонымен қатар алынған білімді өмірлік жағдайларда пайдалануға құлшыныстыарттырады [6]. Геймификацияның *екінші* маңызды аспектісі – командалық рух пен ұжымдық табысты дамытуға қосатын үлесі. Жеке жетістіктерге баса назар аударып қана қоймай, команданың алға қойған мақсатына қарай жалпы ілгерілеуіне ықпал ететін достық бәсекелестікті

ынталандыру арқылы жүзеге асырылады [7]. Геймификацияның *үшінші* аспектісі бұл жаңашылдық пен шығармашылық қабілеттерді дамытуға итермелеуі болып табылса, *төртінші* маңызды аспектісі – кері байланысты тиімді ұйымдастыру және оқушылардың оқу іс-әрекетінің тиімділігін талдау үрдісін едәуір күшейту. Оқушылар аз ұпай жинаған кезде, бұл олардың жетілуіне және дамуына есік ашатындығы туралы нақты сигнал ретінде қызмет етеді. Ойын түріндегі орта прогресті қадағалап, қосымша жұмыс істеуді қажет ететін тұстарды анықтауға жағдай жасайды, бұл өз кезегінде оқушының дағдыларын жақсартуға ықпал етеді [8].

Материалдар мен әдістер

«Оптика» бөлімін оқытуда ойын технологияларын қолдану әдістемесін қарастырайық. Негізі оптика – абстрактілі, теориялық және кейде түсінігі қиын болатын физиканың бір бөлімі. Жарықтың таралуы, шағылуы, сынуы, линзалар, оптикалық құралдар секілді тақырыптарды ойын арқылы түсіндіру оқушыларға қиын материалды жеңіл әрі есте қаларлық түрде қабылдауға мүмкіндік береді.

«Оптика» бөлімі бойынша негізгі ұғымдарды қалыптастыру үшін, алдымен оның құрылымдық бөлімдерінің жіктелуін қарастырайық (1-сурет):

1. **Геометриялық оптика** – жарықтың толқындық және кванттық табиғатын ескерместен, оның біртекті мөлдір орталарда түзусызықты таралу заңдылықтарын зерттейтін оптиканың бөлімі.
2. **Толқындық оптика** – жарықты электромагниттік толқын ретінде қарастырып, оның толқындық қасиеттері байқалатын құбылыстарды (дифракция, интерференция, поляризация, дисперсия) зерттейтін оптиканың бөлімі.
3. **Кванттық оптика** – жарықтың таралуы мен затпен әрекеттесу процестерін фотондар (жарық кванттары) ағыны тұрғысынан зерттейтін оптиканың бөлімі.

1-суретте оптика бөлімінің құрылымдық бөлімдерінің жіктелуі көрсетілген.

1-сурет. Оптиканың құрылымдық бөлімдері

Жоғарыда аталған құрылымдық бөлімдердің ішінде геометриялық оптика жарықтың таралуын қарапайым физикалық модельдер негізінде түсіндіруге мүмкіндік береді, сондықтан алдымен осы бөлімге тоқталамыз. Оқу пәні бойынша оқу жүктемесінің көлемі «Қазақстан Республикасындағы жалпы орта білім берудің үлгілік оқу жоспарларын бекіту туралы» Қазақстан Республикасы Білім және ғылым министрінің 2012 жылғы 8 қарашадағы

№ 500 бұйрығымен бекітілген Үлгілік оқу жоспарына байланысты «Геометриялық оптика» бөлімнің 8-сыныпқа арналған негізгі тақырыптарын атап өтейік [9]:

- Жарықтың түзусызықты таралуы;
- Жарықтың шағылу заңы;
- Жарықтың сыну заңы;
- Линзалар;
- Оптикалық аспаптар және оптикалық жүйелердің қолданылуы.

2-суретте геометриялық оптика бөлімінің негізгі тақырыптары көрсетілген.

2-сурет. «Геометриялық оптика» бөлімінің тақырыптары

Осы тақырыптардың ішінен **«**Жарықтың сыну заңы**»** тақырыбын таңдап алып сабақтың әр кезеңіне байланысты ойын түрлерін қарастырайық. Алдымен осы тақырып бойынша кішкене талдау жасап өтейік.

Жарықтың сыну заңы – физиканың оптика бөліміндегі маңызды тақырыптардың бірі. Бұл заң жарықтың бір ортадан екінші ортаға өткенде бағытын өзгерту құбылысын сипаттайды. Оны түсіну үшін бірқатар негізгі ұғымдарды меңгеру қажет. Оларға:

Түсу бұрышы (α): Жарық сәулесінің екі ортаның шекарасына түскенде, түсу нүктесіндегі шекараға перпендикуляр түсу нормалі мен түскен сәуле арасындағы бұрыш. Ол жарықтың ортаға қалай түсіп тұрғанын көрсетеді.

Сыну бұрышы (γ): Жарық сәулесінің екінші ортаға өткеннен кейін, сол түсу нүктесіндегі нормаль мен сынған сәуле арасындағы бұрыш. Бұл бұрыш жарықтың бағыты қалай өзгергенін білдіреді.

Сыну көрсеткіші (n): Ортаның жарықты сындыру қабілетін сипаттайтын шама. Ол жарықтың вакуумдағы жылдамдығының сол ортадағы жылдамдығына қатынасына тең (n=c/v). Әртүрлі орталардың сыну көрсеткіштері әртүрлі болады (мысалы, ауа үшін n≈1, су үшін n≈1.33, шыны үшін n≈1.5). Оқушыларға бұл мәндердің неліктен әртүрлі екенін және оның жарықтың сынуына қалай әсер ететінін түсіндіру маңызды.

Оптикалық тығыздық жарық үшін ортаның «тығыздығын» білдіретін ұғым. Сыну көрсеткіші жоғары орта оптикалық тығыздығы жоғары болып саналады. Жарық оптикалық тығыздығы аз ортадан оптикалық тығыздығы көп ортаға өткенде нормальға қарай сынады, ал керісінше өткенде нормальдан қашықтайды.

Снелл заңы (сыну заңы): Жарықтың сынуын математикалық түрде сипаттайтын негізгі заң. Ол келесі формуланы білдіреді:

$$n_1 \sin\alpha = n_2 \sin\gamma .$$

Бұл заңды түсіну оқушыларға есептер шығаруға және жарықтың сыну құбылысын тереңірек талдауға мүмкіндік береді.

Оқушыларға бұл ұғымдарды тиімді меңгерту үшін дәстүрлі әдістермен қатар, ойын технологиясын қолдану оқыту процесін қызықты әрі есте қаларлық етеді. Ал сабақтың әр кезеңінде ойын элементтерін қолдану оқушылардың белсенділігін арттырып, тақырыпты жеңіл меңгеруіне ықпал етеді.

1-кесте. Сабақтың әр кезеңінде ойын элементтерін қолдану

Сабақтың кезеңі	Ойын түрі	Берілетін тапсырма	Меңгерілетін ұғымдар
Қызығушылықты ояту	«Кім жылдам?» интерактивті викторина	Презентациядағы ұяшықтардан сұрақтар таңдалып, оқушылар жауап береді: Жарық дегеніміз не?, Оптикалық құбылыстарға не жатады?	Жарық, Оптикалық құбылыстарға шолу
Жаңа сабақты меңгерту	«Сен білесің бе?» жұптық тапсырма	PhET симуляторында тәжірибе жасау: Жарық сәулесінің әртүрлі бетке түсуін бақылау, бұрыштардың өзгеруін зерттеу	Түсу бұрышы, Сыну бұрышы, Сыну көрсеткіші, Снелл заңы
Бекіту	Excel тапсырмасы	Excel-де кесте құрып, Snell заңын тексеру: Бұрыштарды енгізіп, график сызу арқылы тәуелділікті анықтау	Сыну бұрышы, Түсу бұрышы, Сыну көрсеткіші, Снелл заңы
Қорытындылау	«Сәйкестендір» ойыны	Карточкалар арқылы заң элементтерін сәйкестендіру: Түсу бұрышы – α, Сыну бұрышы – γ, Орта көрсеткіштері – n_1, n_2	Түсу бұрышы, Сыну бұрышы, Сыну көрсеткіші, Оптикалық тығыздық
Рефлексия	«Смайлик таңда»	Экранда смайликтер көрсетіледі. Оқушылар өз көңіл-күйі мен түсіну деңгейіне қарай смайлик таңдайды	Өзін-өзі бағалау, Сабақты саралау

1-кестеде жарықтың сынуы тақырыбындағы сабақтың құрылымын сипаттайтын жоспар берілген. Онда әр сабақ кезеңінде не істелетіні, қандай ойын түрі қолданылатыны, қандай тапсырма берілетіні және оқушылар қандай ұғымдарды меңгеретіні нақты көрсетілген.

1. Қызығушылықты ояту кезеңі

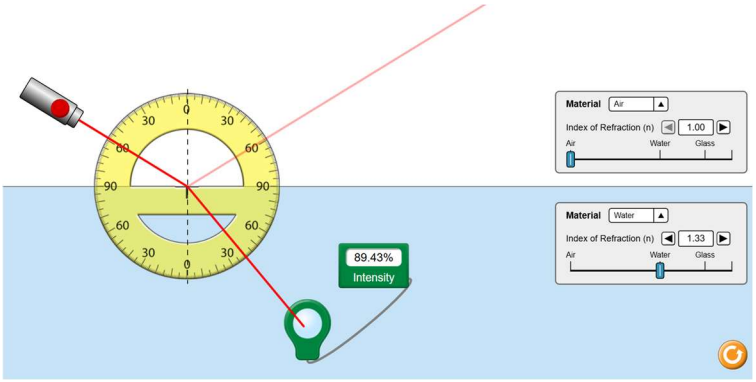
Мақсаты: Оқушылардың назарын сабаққа аудару, қызығушылығын ояту.

Ойын түрі: «Кім жылдам?» (Интерактивті викторина) ойына арқылы, оқушыларға презентациядан кездейсоқ ұяшықтардағы сұрақтарды қойып, тақырыпқа деген қызығушылығын оятып аламыз. Мысалы: «Жарық дегеніміз не?», «Оптикалық құбылыстарға не жатады?».

2. Жаңа сабақты меңгерту кезеңі

Мақсаты: Жаңа ұғымдарды меңгерту (жарықтың сынуы, сыну бұрышы, түсу бұрышы, сыну заңы).

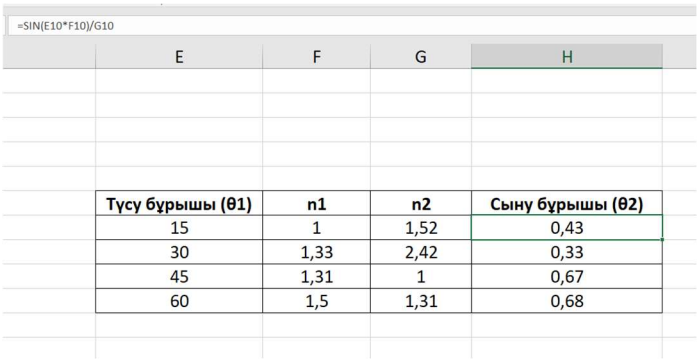
Ойын түрі: «Сен білесің бе?» (Интерактивті жұптық тапсырма) Оқушыларға виртуалды тәжірибе жасайтын платформа (мысалы: PhET Simulation) беру арқылы жұппен орындау. Мысалы: Жарықтың түрлі бетке түсуі кезінде бұрыштардың өзгеруін бақылау, қай кезде сыну бұрышы ең үлкен болатынын анықтау.



3. Бекіту кезеңі

Мақсаты: Тақырыпты меңгеру деңгейін анықтау.

Ойын түрі: Excel-де түсу және сыну бұрышы бойынша кесте құрып, Snell заңын тексеру. График салу (бұрыштар мен сыну көрсеткіштерінің байланысы).

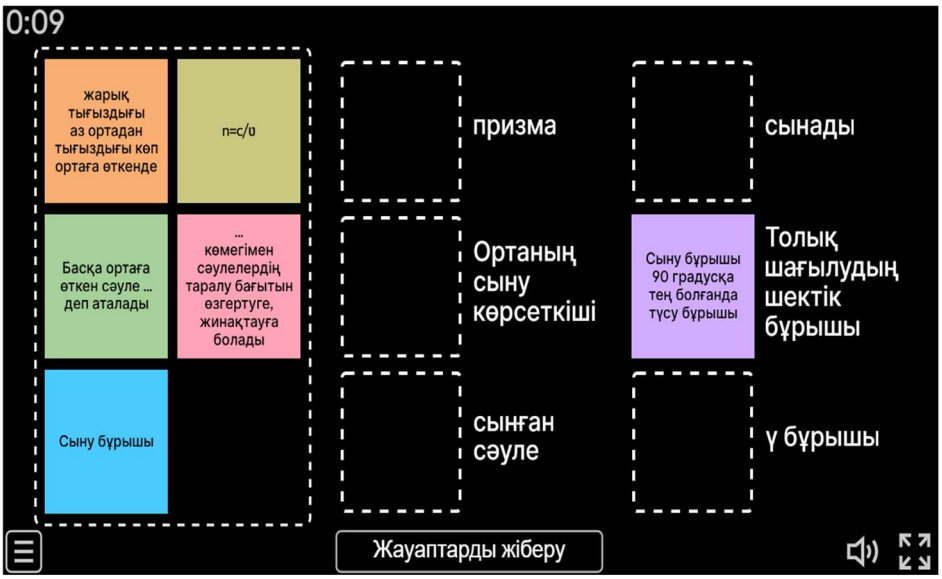


Түсу бұрышы (θ1)	n1	n2	Сыну бұрышы (θ2)
15	1	1,52	0,43
30	1,33	2,42	0,33
45	1,31	1	0,67
60	1,5	1,31	0,68

4. Қорытындылау кезеңі

Мақсаты: Білімді пысықтау, қателіктерді түзету.

Ойын түрі: *«Сәйкестендір»*. Карточкалар арқылы заңның элементтерін (түсу бұрышы, сыну бұрышы, түсетін орта, сынатын орта) сәйкестендіру.



5. Рефлексия

Мақсаты: Сабақта не үйренгенін саралау, өзін-өзі бағалау.

Ойын түрі: «Смайлик таңда». Экранда түрлі смайликтер көрсетіледі (🤔, 😊, 😕). Оқушылар өз көңіл-күйі мен түсіну деңгейіне сай смайлик таңдайды.

Нәтижелер мен талқылаулар

Ойын технологияларын оқу процесінде қолданудың тиімділігін анықтау мақсатына жету үшін педагогикалық эксперимент жүргізіліп, екі түрлі топтың білім нәтижелері салыстырылды. Педагогикалық эксперименттің екі түрі – айырмашылықты бағалау және ілгерілеушілікті бағалау бар екенін ескере отырып, айырмашылықты бағалау критериі таңдалды. Зерттеу барысында Манн-Уитнидің U-критерийі әдісі қолданылды [10]. Бұл әдістің таңдалған себебі – ол екі тәуелсіз топтың рангтік мәліметтерін салыстыруға арналған параметрлік емес статистикалық әдіс болып табылады. Бұл әдіс мәліметтердің қалыпты таралуына тәуелді болмай-ақ, нақты айырмашылықтарды сенімді түрде бағалауға мүмкіндік берді.

Алматы қаласы, Әл-Фараби атындағы мамандандырылған лицейінің 8-сынып оқушыларына ғылыми зерттеу жұмысы бойынша эксперимент жүргізілді. Ойын технологияларын қолданған эксперименттік топ пен дәстүрлі әдіспен оқытылған бақылау топтары салыстырылды. Екі топтың соңғы бақылаудан жинаған білім көрсеткіштерін жинақтап, оларды ранг ретінде қарастырылды.

30 оқушының, соның ішінде ойын технологияларын қолданған 8 «А» сыныбынан 15 оқушы және дәстүрлі оқыту әдісін қолданған 8 «Б» сыныбы бойынша 15 оқушының соңғы бақылаудан алған бағалары 2-кестеде берілген:

2-кесте. Соңғы бақылаудан алған бағалары

Оқушы №	Бағасы	Тобы		Оқушы №	Бағасы	Тобы
1	9	А		16	8	Б
2	10	А		17	6	Б
3	8	А		18	7	Б
4	9	А		19	8	Б
5	10	А		20	7	Б
6	7	А		21	5	Б
7	6	А		22	7	Б
8	9	А		23	6	Б
9	10	А		24	7	Б
10	8	А		25	6	Б
11	7	А		26	8	Б
12	10	А		27	5	Б
13	6	А		28	7	Б
14	9	А		29	6	Б
15	5	А		30	5	Б

Алдымен статистикалық гипотезаларды тұжырымдап алайық:

H0: «Екі таңдаманың таралуы бірдей (яғни, топтар арасында айырмашылық жоқ)»;

H1: «Екі таңдаманың таралуы әртүрлі (яғни, топтар арасында айтарлықтай айырмашылық бар)»;

Барлық бағаларды бір қатарға жинап, ең кішісінен бастап нөмірлейміз. Содан кейін әр сыныптың нәтижелерін рангілейміз. 8 «А» сыныбы үшін рангтардың қосындысы: R1=297,5; 8 «Б» сыныбы үшін рангтардың қосындысы: R2=167,5 болды.

U-критериінің эмпирикалық мәнін есептейік:

$$U = n_1 \cdot n_2 + \frac{n_x \cdot (n_x + 1)}{2} - T_x = 15 \cdot 15 + \frac{15(15+1)}{2} - 297{,}5 = 47{,}5 .$$

Кесте бойынша U-критерийінің критикалық мәні 64-ке тең болды. Алынған эмпирикалық мән бұл критикалық мәннен кіші болғандықтан, нөлдік гипотеза (H0) жоққа шығарылады. Сондықтан, баламалы гипотеза (H1) қабылданады. Басқаша айтқанда, ойын технологияларын қолдану дәстүрлі оқыту әдісіне қарағанда оқушылардың білім сапасына жағымдырақ әсер етеді деген қорытындыға келеміз.

Алайда бұл тұжырымның шынайылығына сенімді болу үшін, p-мәнін (p-value) есептеп, нәтижелердің статистикалық маңыздылығын нақтылаймыз. Бұл үшін алдымен нормаль жуықтау әдісін қолдана отырып Z-статистиканы есептейміз. Ол үшін U-көрсеткішінің күтілетін μ_U орташа мәнін және σ_U стандартты ауытқуын табуымыз қажет:

$$\mu_U = \frac{n_1 \cdot n_2}{2} = \frac{15 \cdot 15}{2} = 112{,}5$$

$$\sigma_U = \sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}} = \sqrt{\frac{15 \cdot 15(15 + 15 + 1)}{12}} = \sqrt{581,25} \approx 24,1$$

Z нормаль жуықтауды есептейік:

$$Z = \frac{U - \mu_U}{\sigma_U} = \frac{47,5 - 112,5}{24,1} = -2,696 \cdot$$

Екі жақты тексеру кезінде Z мәнін р-мәніне айналдырамыз.

Z = – 2.696 болғанда, бір жақты р-мәні:

$$p \approx 0,007.$$

р = 0,007 мәні 0,05-тен аз (р < 0,05), яғни нөлдік гипотеза (H0) жоққа шығарылады. Бұл 8 «А» және 8 «Б» сыныптары арасындағы білім деңгейлерінде айтарлықтай айырмашылық бар екенін көрсетеді. Ойын технологияларын қолдану (8 «А» сыныбы) оқушылардың білім сапасына дәстүрлі әдіске қарағанда жақсырақ әсер етеді.

Қорытынды

Физиканы оқытуда ойын технологияларын қолдану оқушылардың пәнге деген қызығушылығын арттырудың, танымдық белсенділігін күшейтудің және білім сапасын жоғарылатудың тиімді әдістерінің бірі екені дәлелденді. Зерттеу нәтижелері көрсеткендей, ойын элементтерімен ұйымдастырылған сабақтар оқушылардың логикалық ойлау қабілетін, топпен жұмыс істеу дағдысын және оқу мотивациясын дамытуға оң әсер етеді. Әсіресе абстрактілі және күрделі тақырыптарда, мысалы, «Оптика» бөлімінде геймификация әдісін қолдану білімді меңгеру процесін жеңілдетіп, оны есте сақтау тиімділігін арттырады. Статистикалық талдау (Манн-Уитнидің U-критерийі және Z-статистикасы) бұл айырмашылықтың статистикалық тұрғыда маңызды екенін растады (р = 0,007 < 0,05). Бұл ойын технологияларының оқыту үдерісінде нәтижелі құрал бола алатынын дәлелдейді.

Сонымен, физиканы оқытуда ойын технологияларын жүйелі әрі мақсатты түрде қолдану – білім сапасын арттыруға бағытталған заманауи, тиімді әдістемелік тәсіл болып табылады.

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Political Studies

AZERBAIJAN TURKEY STRATEGIC COOPERATION AND ITS GEOPOLITICAL EFFECT

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Summary

The strategic partnership between Azerbaijan and Turkey has recently generated significant geopolitical effects both bilaterally and regionally. This cooperation is rooted in historical-cultural ties, joint energy and transportation projects, military-political alliances, and mutual support in humanitarian fields. The article analyzes the stages of cooperation development, joint projects in energy and transportation, strategic military alliance, geopolitical shifts in the region, and humanitarian aspects. Ultimately, the importance of the Azerbaijan–Turkey tandem in the South Caucasus, the Turkic world, and global energy security is emphasized.

Keywords: Azerbaijan-Turkey cooperation, strategic partnership, energy security, transportation corridors, military alliance, Shusha Declaration, South Caucasus, Turkic Council, regional geopolitics, humanitarian cooperation.

Introduction

Relevance and purpose of the article. The rapid deepening of strategic cooperation between Azerbaijan and Turkey has entered a new stage, especially against the backdrop of geopolitical changes in the region over the past decade. The period after the 2020 Karabakh war has increased the importance of the Baku-Ankara alliance at a time when competition between regional powers has become even more acute. At the same time, the Middle Corridor initiatives, the development of energy and transport infrastructure, the activation of the Organization of Turkic States, and expectations for the Zangezur corridor make this cooperation strategic not only at the level of bilateral relations, but also from a regional and global geopolitical perspective. In this regard, the relevance of the article is due to the need to analyze Azerbaijan-Turkey relations in the context of ensuring peace and stability in the region, energy security, diversification of transport routes, and the reshaping of the regional balance of power.

Purpose of the article. The aim of this study is to examine the stages of formation of strategic cooperation between Azerbaijan and Turkey, its main directions, and the geopolitical impacts of this cooperation in the South Caucasus and the wider Eurasian space, and to systematically assess the consequences of this model in terms of regional security and integration. The strategic cooperation model formed between Azerbaijan and Turkey has become one of the main factors shaping not only bilateral relations, but also the general geopolitical architecture of the region. These relations, which have developed from fraternal relations to strategic partnership, are yielding important results in areas such as energy security, military cooperation, transport corridors, and regional balance. Especially after the Second Karabakh War in 2020, this cooperation has entered a new stage.

Historical Context and Formation of Cooperation. The basis of Azerbaijan-Turkey relations is a deep historical, cultural, and linguistic unity. In addition to having common ethnic-cultural roots, religious and spiritual values, both peoples have also united around the ideas of a common national struggle since the end of the 19th century. Especially at the beginning of the 20th century, during the Azerbaijan Democratic Republic, the main political foundation of these relations was formed, and the participation of the Caucasian Islamic Army under the command of Nuru Pasha in the liberation of Baku in 1918 was the first real example of military-political solidarity between the two peoples [8].

With the restoration of Azerbaijan's state independence in 1991, relations between the two states entered a new stage. Turkey, in addition to being the first state to recognize Azerbaijan's independence, also opened its first embassy in Baku. Since 1992, bilateral political, economic, military and humanitarian relations have been developing consistently. The main goal at this stage was mutual economic support, the establishment of diplomatic relations and the establishment of the foundations of cooperation in the field of security.

The "Treaty on Strategic Cooperation and Mutual Assistance" signed in 2009 raised Azerbaijan-Turkey relations to a higher level from a legal and institutional perspective. This document established the obligation of both states to provide mutual assistance in matters related to each other's sovereignty, territorial integrity and national security and showed that relations had gone beyond the framework of friendship and brotherhood and had become strategic in nature [3].

Joint projects in the energy sector, in particular the Baku-Tbilisi-Ceyhan (BTC), Baku-Tbilisi-Erzurum (BTE) and the Trans-Anatolian Gas Pipeline (TANAP), played a major role in strengthening relations. These projects have made Azerbaijan and Turkey not only economic partners, but also key participants and guarantors of energy and transport security.

The victory of the Azerbaijani Army in the Karabakh War in 2020 and the diplomatic and military-political support provided by Turkey in this process have further changed the nature of relations. The "Shusha Declaration" signed in Shusha in 2021 formalized the strategic alliance of the two countries. This document, in addition to further strengthening mutual defense and military cooperation, also sent an important political message for the integration of the Turkic world. Thus, Azerbaijan-Turkey relations have transformed from friendship into a strategic alliance over time, and this alliance has had a significant geopolitical impact in the South Caucasus, Central Asia, and the Eurasian space as a whole.

The historical roots of Azerbaijan-Turkey relations are built on deep cultural, ethnic, and linguistic unity. Turkey, the first state to recognize Azerbaijan's independence in 1991, has provided unequivocal support for Azerbaijan's sovereignty and territorial integrity from the very first day. The "Treaty on Strategic Cooperation and Mutual Assistance" signed in 2009 put these relations into a legal framework and elevated the relations to a strategic level [3].

Partnership in Energy and Transport Security. One of the most important pillars of strategic cooperation between Azerbaijan and Turkey is the system of common interests and projects formed in the field of energy and transport. This cooperation aims not only at the economic development of the two countries, but also at ensuring energy and logistical security between Europe and Asia. While Azerbaijan plays the role of a major producer and transit country in exporting the region's energy resources to Western markets, Turkey serves as its strategic route partner and gateway to the market.

Cooperation with Turkey in the field of exploitation and export of Azerbaijan's rich hydrocarbon resources has become a main pillar of energy diplomacy, starting with the Baku-Tbilisi-Ceyhan (BTC) oil pipeline project in the late 1990s. The BTC project, which was commissioned in 2006, created an alternative energy corridor from the Caspian Sea basin to the Mediterranean, giving the Azerbaijan-Turkey tandem a strategic advantage [18]

This line was followed by the Baku-Tbilisi-Erzurum (BTE) gas pipeline, which ensured the export of natural gas from Azerbaijan's Shah Deniz field to the world market via Turkey. The culmination of energy cooperation was the Trans-Anatolian Gas Pipeline (TANAP), which was commissioned in 2018. The TANAP project is a key component of the "Southern Gas Corridor" that transports Azerbaijani gas to Europe and is an important geopolitical project that serves to diversify energy resources. Through this project, both Azerbaijan and Turkey have gained the status of guarantors of Europe's energy security [19]. As in the energy sector, Azerbaijan-Turkey cooperation in the transport and logistics sector is developing within a strategic framework. The Baku-Tbilisi-Kars (BTK) railway line, which was opened in 2017, forms the main link of the Middle Corridor connecting Asia and Europe. Through this project, both cargo and passenger transportation are carried out more efficiently, quickly and safely. The BTK project is also gaining relevance as an alternative route for China-Europe freight transport and creates an opportunity to adapt to the "One Belt, One Road" initiative.

The Zangezur corridor project, which is currently on the agenda, is further deepening this cooperation. If this corridor is fully implemented, a direct land transport connection will be established between Azerbaijan and Turkey, and the route passing through Nakhchivan will become a strategic corridor connecting Turkey with the Central Asian and Chinese markets. At the same time, this will form a new balance of power in the transport architecture of the South Caucasus and strengthen Azerbaijan's role as a transit hub in the region [1].

The security of energy and transport infrastructure is a priority area for Azerbaijan and Turkey. The parties are working together in this area in terms of cybersecurity, joint measures against sabotage risks, border security and regional stability. After 2020, coordination between the two countries has also deepened on issues of military and technical protection of energy facilities.

Thus, Azerbaijan-Turkey cooperation in the energy and transport sectors has become a multidimensional model of joint action that serves not only economic benefits, but also geopolitical shifts, strategic interdependence and regional integration.

Cooperation in the energy sector between Azerbaijan and Turkey has become one of the main pillars of energy security in the region. TANAP, BTC and BTE projects, in addition to being alternative energy routes for Europe, have also increased the geopolitical weight of the two states [19]. Projects such as the Middle Corridor and the Zangezur corridor take cooperation to a new level of regional integration.

Strategic Alliance in the Military-Security Field. Military cooperation between Azerbaijan and Turkey has in recent years moved beyond the technical-training level and has risen to the level of a deeper strategic alliance. This cooperation not only strengthens the national defense capabilities of the two states, but has also become one of the main geopolitical factors changing the balance of power in the South Caucasus and the immediate region.

Treaty basis and legal foundations. The legal basis of military cooperation is the "Treaty on Strategic Partnership and Mutual Assistance between the Republic of Azerbaijan and the Republic of Turkey", signed in 2010. This document contains the principle that a threat or attack against the security of one state is also directed against the other. This in fact expresses the obligation of collective defense and creates a bilateral security umbrella in a format similar to Article 5 of NATO [4].

Shusha Declaration and the strategic stage. The "Shusha Declaration on Alliance between the Republic of Azerbaijan and the Republic of Turkey", signed in Shusha on June 15, 2021, brought this cooperation to its peak. The declaration covered issues such as expanding cooperation in the military and defense industry of the two states, conducting joint military exercises, transferring military technologies, and mutually strengthening defense capabilities. In addition, the document

also emphasized strengthening the Organization of Turkic States and political coordination on common security issues [15].

Joint exercises and military-technical cooperation. The joint military exercises “TurAz Eagle”, “Mustafa Kemal Atatürk” and “Brotherly Fist” held in recent years show that Azerbaijan-Turkey military coordination has intensified at a practical level. These exercises are important in terms of the interaction of both ground forces, air defense, and special forces. Through such exercises, the parties increase joint operational readiness and deepen the exchange of military technology and tactics. In addition, Turkey has played a significant role in the modernization of the Azerbaijani Armed Forces - in particular, in the provision of unmanned aerial vehicles, intelligence and communication technologies. The use of Bayraktar TB2 UAVs in the 2020 Patriotic War was one of the decisive factors in ensuring Azerbaijan's military superiority, which proved the effectiveness of Ankara-Baku military-technical cooperation [6].

Coordination in regional security. The joint military strategy of Azerbaijan and Turkey is aimed at peace and security in the region. In the context of the normalization of relations with Armenia, both states support the model of a "security architecture built on stability and mutual trust". In this context, the Zangezur corridor, the military defense of Nakhchivan, and the balancing of existing peacekeeping systems in the Caucasus are priority areas. Thus, Azerbaijani-Turkish military cooperation is no longer limited to bilateral security relations, but also plays a decisive role in shaping peace and the balance of power in the geopolitical architecture of the region. The Shusha Declaration, signed in 2021, is considered the pinnacle of the military-political alliance between the two countries. This document promises military defense, defense industry, joint military exercises, and mutual support against threats. As a result, Azerbaijan has strengthened its defense capabilities in the region, and Turkey has become a geopolitical actor in the South Caucasus [6].

Regional and Global Geopolitical Effects. The developing strategic cooperation model between Azerbaijan and Turkey creates significant geopolitical effects not only at the level of bilateral relations, but also in the South Caucasus, Central Asia, the Middle East, and Europe as a whole. This cooperation not only forms new balances of power in the fields of energy, transport, military security and political diplomacy, but also plays an important role in terms of consolidating the Turkic world in a multipolar world order.

The change in the balance of power in the South Caucasus. After the Second Karabakh War, Turkey's political and military support for Azerbaijan significantly increased this country's influence in the South Caucasus. This led to the formation of a new regional power - the Azerbaijan-Turkey tandem - against the influence of traditional power centers such as Russia and Iran in the region. At the same time, it showed how risky it is to build Armenia's security architecture solely on Russia and created the need for alternative regional integration mechanisms [9].

Turkey's increasing activity in the South Caucasus also indirectly strengthens NATO's interests in the region, and this process increases the effects of the West-Russia confrontation on the region. Azerbaijan, by pursuing a balanced policy in this configuration, both strengthens its alliance with Turkey and maintains its relations with other major powers.

A catalytic role in the integration of the Turkic world. Azerbaijan-Turkey cooperation also plays an important strategic role within the framework of the Organization of Turkic States (OTS). Both states promote integration between the countries of the Turkic world in the fields of energy, transport, digital transformation, defense, and cultural diplomacy. The “Turkic World 2040” vision document adopted at the TDT Summit in Baku in 2021 also defined strategic goals in this direction. Azerbaijan’s energy resources and logistical capabilities, combined with Turkey’s geopolitical position and regional power, form the main gateway to the West in Central Asia. This tandem also

plays the role of a regional platform coordinating the interests of countries located along the Middle Corridor.

The Ankara-Baku line in the energy security of Europe and Asia. The delivery of Azerbaijani gas to Europe through TANAP and TAP is fully consistent with the European Union's energy diversification policy. The West's desire to reduce energy dependence, especially against the backdrop of the Russia-Ukraine war, has given strategic weight to the Baku-Ankara energy line [20]. In this sense, Azerbaijan-Turkey cooperation has become not only a regional but also a part of global energy policy. This cooperation has also led to the emergence of new trilateral and multilateral cooperation formats with Italy, Georgia, Bulgaria and other countries in the region

Iran and Russia's concerns and counter-strategies. The Azerbaijan-Turkey rapprochement is being closely monitored by Iran and Russia in the region. In particular, the implementation of the Zangezur corridor project could weaken Iran's transit position in the north. To balance this situation, Iran is seen trying to deepen relations with Armenia, while Russia is trying to increase its military and peacekeeping presence in the South Caucasus. However, Azerbaijan-Turkey cooperation is aimed at maintaining stability rather than creating new conflicts in the region, and this policy is in line with Azerbaijan's balanced and pragmatic diplomacy. Thus, the Azerbaijan-Turkey strategic alliance, in addition to changing the regional balance of power, is also giving impetus to the integration of the Turkic world, ensuring Europe's energy security, and forming a new geopolitical configuration in the Eurasian space. A number of geopolitical effects of the strategic cooperation are being observed in the South Caucasus and the wider Eurasian space:

New dynamics in the balance between Russia and Iran: The Azerbaijan-Turkey rapprochement creates a new geopolitical shift in the influence of these two states in the South Caucasus.

Compliance with Western interests: Energy and transport projects are supported by the European Union and the United States.

Activation of the Organization of Turkic States: The Baku-Ankara tandem has a nuclear function for the integration of the Turkic world. Humanitarian and Social Aspects. Strategic cooperation between Azerbaijan and Turkey is not limited to political, military and economic spheres; these relations are also deepening in the humanitarian and social spheres. There are strong ties between the two brotherly countries in the fields of culture, education, science and media, which strengthen mutual understanding and unity between the peoples. Cooperation in the field of education and science. Cooperation between Turkish and Azerbaijani universities is expanding. Educational exchange programs, joint scientific research projects and student exchanges bring the young generations of the two countries closer together. Turkic World Studies and Turkological Centers play an important role in the development of relations in this area. This also strengthens the ideological foundations of the integration process [17].

Culture and media. The cultural values of the peoples are getting closer to each other through joint festivals, exhibitions and art projects in the field of culture. Events held on music, literature and folklore of the Turkic world demonstrate the dynamism of humanitarian cooperation. In the media field, joint television programs, news and documentaries serve to create stronger information bridges between the brotherly peoples.

Diaspora and public diplomacy. Turkish and Azerbaijani diaspora organizations play an important role in mutual support and development of relations. Diaspora diplomacy contributes to increasing the international prestige of the two countries and conveying historical truths to the world community. In particular, the activity of the diaspora in the issue of Western Azerbaijan is assessed as part of strategic cooperation in both legal and informational terms

Social integration and humanitarian assistance. Turkey is an important partner of Azerbaijan in the restoration of social and humanitarian infrastructure in conflict-affected areas. Mutual assistance in education, health and social security programs acts as the main elements of humanitarian

cooperation. These processes are important for increasing mutual trust and ensuring long-term peace in the region. Thus, cooperation in the humanitarian and social sphere is one of the main pillars of Azerbaijan-Turkey strategic relations and strengthens cultural solidarity, social integration and mutual understanding between peoples. Turkey-Azerbaijan cooperation has not remained only in the political and economic framework, but has also deepened in the fields of education, culture, media and diaspora diplomacy. Educational exchanges and cultural projects through TIKA, YTB and other institutions have also made cooperation effective at the level of public diplomacy.

Conclusions and Recommendations

Azerbaijan-Turkey strategic cooperation has led to fundamental changes in the political, economic, military and humanitarian spheres of the region in recent years. This cooperation has led to the formation of new balances of power in the region as a result of the synchronization of the national interests of the two brotherly countries and their orientation towards common geopolitical goals.

Starting from the historical roots examined in the article, aspects of cooperation in the energy, transport, military security and humanitarian fields have strengthened Azerbaijan's role in the region and made Turkey a decisive regional actor in the South Caucasus. At the same time, this tandem serves as an important catalyst in the integration of the Turkic world and ensuring Europe's energy security

Recommendations:

1. **Multidimensional development of cooperation**: It is important to expand existing projects in energy and transport infrastructure, explore opportunities for integration into new regional and global initiatives.
2. **Improving military cooperation**: Increasing the number and quality of joint military exercises, technology transfer and the application of innovations in the field of defense industry should be prioritized.
3. **Deepening relations in the humanitarian and social spheres**: Expanding joint programs in the fields of education, culture, diaspora and public diplomacy will strengthen solidarity and mutual understanding between peoples.
4. **Regional peace and security:** Supporting Azerbaijan's balanced diplomacy and strengthening joint activities with Turkey to strengthen peace in the region should be a strategic goal.
5. **Global energy security**: The importance of TANAP and other projects should be increased in the direction of diversifying energy supplies to European markets, and new routes and technologies should be introduced. Strong strategic cooperation between Azerbaijan and Turkey will continue to play a leading role in ensuring the sustainable development, security and economic integration of the region in the future.

The strategic cooperation model between Azerbaijan and Turkey is one of the rare partnerships that serves not only bilateral interests, but also regional stability and global energy security. This cooperation will continue to play a decisive role in the coming period, both in the integration of the Turkic world and in the formation of a new balance of power in the Eurasian space.

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Historical Sciences

Тарих сабағында қазақ хандарының әлеуметтік-саяси реформаларын оқытуда қолданылатын жаңа әдістері

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Аңдатпа

Бұл мақалада тарих сабағында Қазақ хандығы кезеңіндегі хандардың әлеуметтік-саяси реформаларын оқыту барысында қолданылатын заманауи педагогикалық әдістер қарастырылады. Қазақ хандары жүргізген реформалар – ел басқару жүйесін жетілдіру, ру-тайпалар арасындағы бірлікті нығайту, құқықтық тәртіп орнату және әлеуметтік әділеттілікті қамтамасыз етуге бағытталған тарихи маңызды өзгерістер. Мақалада оқушылардың тарихи танымын арттыру мақсатында жаңа тәсілдер: цифрлық технологиялар, тарихи симуляциялар, кейс-стади, уақыт сызығы, инфографика және проблемалық оқыту әдістерінің тиімділігі талданады.

Қазіргі білім беру жүйесінде оқушының сыни ойлауын, тарихи пайымдауын дамыту өзекті мәселе. Осы тұрғыда, Қазақ хандарының реформаларын заманауи әдістер арқылы оқыту – тарихты жаңаша түсінуге жол ашады және тарихи сана қалыптастыруға ықпал етеді.

Тарих сабағында Қазақ хандарының әлеуметтік-саяси реформаларын оқытуда жаңа әдістердің мазмұнын ашу және олардың оқушы жетістігіне әсерін негіздеу.

Жаңа оқыту әдістері оқушылардың танымдық белсенділігін арттырып, тарихи білімдерін өмірмен байланыстыруға мүмкіндік береді.

Кілт сөздер: Қазақ хандары, әлеуметтік-саяси реформалар, тарих сабағы, жаңа әдістер, оқытудың тиімділігі, сыни ойлау, тарихи сана.

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Аннотация

В данной статье рассматриваются современные педагогические методы, применяемые при изучении социально-политических реформ казахских ханов на уроках истории. Реформы, проводимые казахскими ханами, были направлены на совершенствование системы управления, укрепление единства между родами и племенами, установление правопорядка и обеспечение социальной справедливости. В статье анализируется эффективность таких новейших методов обучения, как цифровые технологии, исторические симуляции, кейс-стади, временная шкала, инфографика и проблемное обучение, с целью повышения исторической грамотности учащихся.

В современной системе образования важнейшей задачей является развитие у учащихся критического мышления и исторического понимания. В этом контексте обучение социально-политическим реформам казахских ханов с использованием современных методов способствует формированию исторического сознания и новому осмыслению прошлого.

Раскрыть содержание новых методов обучения в преподавании социально-политических реформ казахских ханов и обосновать их влияние на успеваемость и познавательную активность учащихся.

Современные методы обучения способствуют повышению познавательной активности учеников и позволяют связать исторические знания с реальной жизнью.

Ключевые слова: Казахские ханы, социально-политические реформы, урок истории, новые методы, эффективность обучения, критическое мышление, историческое сознание.

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Annotation

This article explores modern pedagogical methods used in teaching the socio-political reforms of Kazakh khans in history lessons. The reforms implemented by the Kazakh khans were aimed at improving governance, strengthening unity among tribes and clans, establishing legal order, and ensuring social justice. The article analyzes the effectiveness of innovative teaching approaches such as digital technologies, historical simulations, case studies, timelines, infographics, and problem-based learning in enhancing students' historical literacy.

In today's education system, developing students' critical thinking and historical understanding is a key priority. In this regard, teaching the socio-political reforms of Kazakh khans through modern methods contributes to a renewed interpretation of history and the formation of historical consciousness.

To explore the content of new teaching methods in the context of studying the socio-political reforms of Kazakh khans and to substantiate their impact on students' academic performance and cognitive engagement.

Innovative teaching methods increase students' cognitive activity and help connect historical knowledge with real-life contexts.

Keywords: Kazakh khans, socio-political reforms, history lesson, modern methods, teaching effectiveness, critical thinking, historical consciousness.

Кіріспе. Қазақ хандығының тарихы – ұлттық мемлекетіміздің қалыптасуы мен дамуындағы маңызды кезеңдердің бірі. Әсіресе, қазақ хандары жүргізген әлеуметтік-саяси реформалар елдің ішкі тұрақтылығы мен басқару жүйесінің жетілуіне тікелей әсер етті. Бұл реформалар арқылы билік пен заңдылық мәселелері шешіліп, қоғамда тәртіп пен әділеттілік орнықты. Алайда бүгінгі ұрпақ үшін бұл тарихи үрдістерді жалаң деректер ретінде емес, жан-жақты сарапталған, терең мағыналы құбылыс ретінде түсіндіру қажеттілігі туындайды.

Қазіргі таңда білім беру саласы түбегейлі өзгерістерге ұшырап, оқыту үрдісінде оқушылардың белсенділігін, сыни ойлау қабілетін арттыратын әдіс-тәсілдер кеңінен қолданылуда. Осы орайда, тарих сабағында қазақ хандарының әлеуметтік-саяси реформаларын оқытуда дәстүрлі тәсілдермен қатар, жаңартылған және инновациялық әдістерді пайдалану өзекті мәселе ретінде алға шығады.

Оқушылардың тарихи білімін өмірмен ұштастырып, олардың тарихи санасын қалыптастыруда заманауи әдістер шешуші рөл атқарады.

Қазақ хандарының реформаларын жаңа педагогикалық тәсілдер арқылы оқыту тарихи оқиғаларға қызығушылықты арттырып, ұлттық құндылықтарға негізделген білім алуға мүмкіндік береді.

Негізгі бөлім. Қазақ хандығы кезеңіндегі әлеуметтік-саяси реформалар – отандық тарихтың маңызды құрамдас бөлігі ретінде оқушының тарихи санасын, азаматтық ұстанымын және ұлттық құндылықтарға деген көзқарасын қалыптастыруда маңызды орын алады. Әсіресе хандық билікті нығайту, билер кеңесінің қызметі, «Жеті жарғы» сияқты құқықтық нормалардың қалыптасуы, руаралық бірлікті сақтау – барлығы реформалардың нақты көрінісі ретінде қарастырылады. Бұл тарихи үрдістерді мектеп курсында тиімді меңгерту үшін заманауи білім беру технологияларын қолдану қажет.

Қазіргі заманғы білім беру жүйесінде дәстүрлі баяндау әдісімен қатар, оқушыны сабаққа белсенді тартатын, оны тарихи үдерістерге қатысушы ретінде сезіндіретін интерактивті және инновациялық әдістерге басымдық беріліп отыр. Педагогикалық зерттеулер көрсеткендей, заманауи әдістер оқушылардың танымдық қызығушылығын арттырып, тарихи білімді терең әрі жүйелі меңгеруге мүмкіндік береді [1].

Оқыту барысында қолдануға болатын жаңа әдістердің бірі – кейс-стади (жағдаяттық талдау). Бұл тәсіл арқылы оқушылар белгілі бір тарихи кезеңде қазақ хандары қабылдаған шешімдерді талдайды, оның себеп-салдарын анықтайды. Мысалы, Тәуке ханның билік жүргізуіндегі "Жеті жарғыны" енгізу реформасын кейс ретінде ұсынып, оқушылар оның заманына сәйкес қажеттілігін, артықшылықтары мен шектеулерін талдай алады. Мұндай тапсырмалар оқушының тарихи деректерге аналитикалық тұрғыдан қарауына мүмкіндік береді.

Тағы бір тиімді әдіс – интерактивті уақыт сызығы құрастыру. Бұл тәсіл арқылы оқушылар қазақ хандарының билік кезеңін, реформалардың жүзеге асу динамикасын, тарихи оқиғалар арасындағы байланыстарды көрнекі түрде түсінеді. Мұндай визуалды тәсілдер оқушыда тарихи хронологияны нақты қабылдауға, себеп-салдарлық байланысты түсінуге септігін тигізеді.

Инфографика мен цифрлық карталар қолдану да маңызды әдістердің бірі болып табылады. Мысалы, хандықтың аумағындағы өзгерістерді немесе ру-тайпалық құрылымның реформа нәтижесінде қалай өзгергенін интерактивті картада көрсету – оқушыларға кеңістіктік ойлауды дамытуға мүмкіндік береді. Сонымен қатар, заманауи зерттеулер көрсеткендей, визуалды мәліметтерді қабылдау оқушыларда ақпаратты ұзақ мерзімге есте сақтауға ықпал етеді [2].

Проблемалық оқыту әдісі – әлеуметтік-саяси реформалардың тарихи маңызын терең ұғындыруда ерекше рөл атқарады. Мысалы, "Егер Тәуке хан 'Жеті жарғыны' енгізбегенде, Қазақ хандығында қандай саяси дағдарыстар орын алар еді?" деген сұрақтар арқылы оқушылар өз пікірін дәлелдеуге, тарихи тұрғыда ой қорытуға үйренеді. Бұл әдіс тарихи фактіні меңгеруден гөрі, оны түсінуге, себеп-салдарлық талдау жасауға бағытталады.

Қазақ хандарының реформаларын оқытқанда AR/VR технологияларын пайдалану – оқушылардың сабаққа деген қызығушылығын күрт арттырады. Мысалы, Тәуке ханның билік құрған кезеңін 3D визуализация арқылы көрсету немесе Абылай ханның резиденциясын виртуалды түрде аралату – тарихи оқиғаларды сезінуге, елестетуге мүмкіндік береді. Бұл әдіс, әсіресе, визуалды-кеңістіктік ойлауы жақсы дамыған оқушылар үшін өте тиімді.

Сонымен қатар, жобалық оқыту әдісі арқылы оқушылар шағын зерттеу жобаларын жасап, қазақ хандарының реформаларын қазіргі басқару жүйесімен салыстыра алады. Бұл тәсіл оқушыны тек тарихи фактіні меңгеруші емес, оны талдаушы және жаңа шешім ұсынушы ретінде қалыптастырады [3].

Сын тұрғысынан ойлауға негізделген тапсырмалар да оқушылардың тарихи санасын дамытуда ерекше орын алады. Мысалы, "Қасым хан мен Есім ханның реформалық бағыттарын салыстырып, қайсысы тиімді болды?" деген тапсырмалар оқушылардың салыстыру, дәлелдеу, қорытынды жасау қабілеттерін дамытады. Мұндай тапсырмалар арқылы оқушылар тек білім алып қоймай, өз көзқарасын қалыптастырады, тарихи тұлғаларға баға береді.

Сабақ барысында топтық жұмыстар мен дебат элементтерін қолдану арқылы оқушылар арасында пікір алмасу, тарихи мәселелерге қатысты көзқарас білдіру мәдениеті қалыптасады. Бұл тәсіл олардың коммуникативтік дағдыларын дамытып, ынтымақтастықта жұмыс істеуге үйретеді.

Бұдан бөлек, блум таксономиясына негізделген тапсырмалар жүйесін қолдану арқылы оқушылардың танымдық дағдыларын біртіндеп жоғарылатуға болады. Мысалы, алғашқы тапсырмаларда тарихи фактілерді есте сақтау талап етілсе, келесі кезеңдерде салыстыру, талдау, бағалау және жаңа ұсыныстар жасау секілді күрделірек тапсырмалар беріледі. Бұл тәсіл оқытудың сапасын арттырып, нәтижелілігін күшейтеді [4].

Жалпы алғанда, жаңа әдістер мен тәсілдер оқушылардың білімге деген қызығушылығын арттырып қана қоймай, олардың тарихи оқиғаларға қатысты сыни көзқарасын қалыптастыруға, білімді терең әрі жан-жақты меңгеруіне ықпал етеді. Сонымен қатар, бұл әдістер оқушының шығармашылық қабілетін, зерттеушілік дағдыларын, коммуникация мәдениетін дамытудың тиімді құралы ретінде танылады [5].

Зерттеу бөлімі. Зерттеу жұмысының мақсаты – тарих сабағында қазақ хандарының әлеуметтік-саяси реформаларын оқытуда жаңа әдістердің тиімділігін тәжірибе жүзінде тексеру және олардың оқушының оқу белсенділігіне, тарихи санасына әсерін бағалау.

Зерттеу 2024–2025 оқу жылында қаладағы Павлодар қаласындағы Шапық Шөкин атындағы жалпы білім беретін мектептің 6-сынып оқушылары арасында жүргізілді. Жалпы зерттеуге 50 оқушы қамтылды. Олар екі топқа бөлінді: бақылау тобы (дәстүрлі оқыту әдістерімен оқытылды) және эксперименттік топ (жаңа әдістермен оқытылды).

Зерттеу үш негізгі кезеңнен тұрды:

1. Диагностикалық кезең – оқушылардың бастапқы тарихи білім деңгейі, пәнге қызығушылығы және тарихи ойлау дағдылары сауалнама, тест және әңгімелесу арқылы анықталды.
2. Негізгі кезең – эксперименттік топта заманауи әдістер енгізілді: кейс-стади, инфографика, тарихи симуляциялар, уақыт сызығы, AR/VR технологиялары және дебат элементтері қолданылды.
3. Қорытынды кезең – соңғы тест, бақылау жұмысы және сауалнама нәтижелері салыстырмалы түрде талқыланды.

Интерактивті оқыту – оқушылардың белсенді әрекетіне негізделген, олардың өзара қарым-қатынас жасауына мүмкіндік беретін тәсіл. Қазақ хандарының реформаларын меңгертуде төмендегідей интерактивті әдістер қолданылады (сурет – 1):

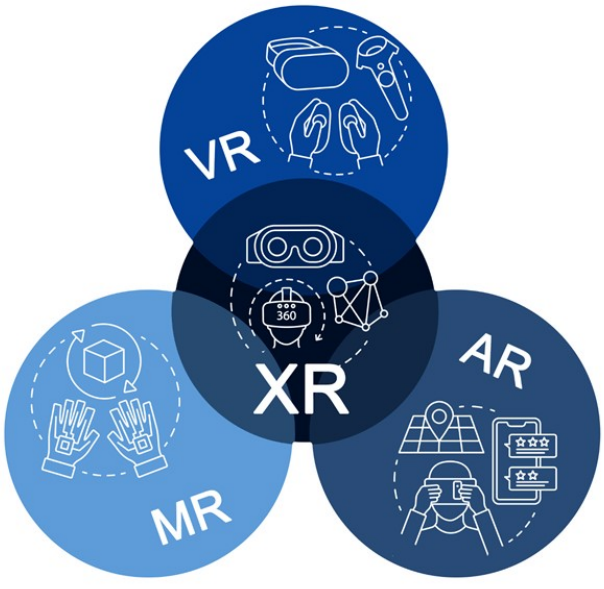
Инфографика жасау: Оқушылар әр ханның саяси әрекеттері мен реформаларын визуалды түрде инфографикаға түсіріп, уақыт шкаласы бойынша ұсыну арқылы тарихи оқиғалардың реттілігін меңгереді

Тарихи дебат: Хандардың белгілі бір реформасына байланысты екі жақты пікірталас ұйымдастырылып, оқушылар тарихи дәлелдерге сүйене отырып, өз көзқарасын қорғайды

Кейс-стади (жағдаяттық талдау): Мысалы, Абылай ханның Ресей мен Қытай арасындағы саясатын модельдеу арқылы оқушылар нақты тарихи жағдайда қандай шешім қабылдауға болатынын талқылайды

Сурет 1 – Интерактивті оқыту түрлері

Тарих сабағында Қазақ хандарының әлеуметтік-саяси реформаларын оқытуда қолданылатын жаңа әдістер оқушылардың қызығушылығын арттырып, тарихи танымын тереңдетуге бағытталған. Қазіргі таңда білім беру үдерісінде цифрлық технологияларды пайдалану – заман талабы. Осы тұрғыда қосымша және виртуалды шындық (AR/VR) платформалары кеңінен қолданылып келеді (сурет – 2).



Сурет 2 – виртуалды шындық (AR/VR) платформалары арқылы оқыту

Мысалы, оқушылар Қазақ хандығының астанасы болған Түркістан қаласының үлгісін немесе Абылай ханның резиденциясын виртуалды аралау арқылы елестету қабілетін дамыта алады. Сонымен қатар тарихи онлайн-ойындар мен симуляциялық бағдарламаларда хан рөлін ойнап, нақты тарихи жағдайларда шешім қабылдау мүмкіндігі оқушыларға оқиғаның мәнін тереңірек түсінуге жағдай жасайды [6].

Тағы бір тиімді әдіс – жобалық және зерттеу тәсілдері. Оқушыларға белгілі бір тақырып аясында өз бетінше ізденіс жүргізуге мүмкіндік беру олардың тарихи деректермен жұмыс істеу машығын дамытады. Мысалы, «Қасым ханның қасқа жолы» реформасына байланысты макет жасап немесе «Тәуке ханның Жеті жарғысы» негізінде тарихи көрме ұйымдастыру – оқушылардың шығармашылығын арттырады. Зерттеу жұмысында оқушылар әр ханның тұсында жүзеге асқан реформалардың әлеуметтік салдарға тигізген ықпалын салыстырып, өз тұжырымын жасай алады [7].

Сондай-ақ модельдеу және рөлдік ойын әдістері де аса тиімді. «Хан кеңесі» симуляциясында оқушылар Қасым хан, Тәуке хан, Абылай хан сияқты тарихи тұлғалардың рөлін сомдай отырып, сол дәуірдің саяси мәселелерін талқылайды. «Уақыт саяхаты» жобасы арқылы әр топ өзіне берілген кезеңді сахна арқылы бейнелеп, көрініс ретінде ұсынады. Мұндай іс-әрекеттер оқушылардың тарихи санасын қалыптастырып, оқиғаға терең бойлауына мүмкіндік береді (сурет – 3).

Сурет 3 – жаңа оқыту технологиялары мен әдістерінің түрлері

Тарих сабағында сыни ойлау қабілетін қалыптастыру да маңызды. Бұл бағытта тарихи құжаттар мен деректерді салыстырып талдау – тиімді тәсілдердің бірі. Мысалы, «Жеті жарғы» нормаларын қазіргі заң жүйесімен салыстыру оқушылардың құқықтық ойлауын дамытады. Сондай-ақ «Егер сіз хан болсаныз...» сияқты эссе жазу немесе тарихи шешімдердің ықтимал салдарын болжау секілді тапсырмалар да сыни ойлауға негізделген [8].

Картографиялық әдіс пен хронологиялық кестелерді пайдалану тарихи үдерістерді кеңістікте және уақытта жүйелі түрде түсіндіруге көмектеседі. Оқушылар тарихи карталар арқылы әр ханның тұсында Қазақ хандығының шекарасының кеңеюі немесе тарылу себептерін көрнекі түрде байқай алады. Сонымен қатар хронологиялық кесте құрастыру арқылы хандардың билік кезеңіндегі маңызды реформалар мен өзгерістерді жүйелеу жүзеге асырылады.

Интеграцияланған сабақтар өткізу – оқытудың мазмұнын байыта түседі. Әдебиетпен байланыс орнатып, Қазақ хандары туралы жыр-дастандар мен тарихи романдарды дереккөзі ретінде талдау тарихи оқиғаларды көркем шығармалармен ұштастыруға мүмкіндік береді. Сонымен қатар құқық пәнімен кіріктірілген сабақтар арқылы Қазақ хандығының заң жүйесін қазіргі құқықтық нормалармен салыстыру оқушыларда құқықтық сана мен тарихи танымды қатар дамытады [9].

Қазақ хандарының әлеуметтік-саяси реформаларын тарих сабағында оқыту – тек тарихи фактілерді меңгеру ғана емес, оқушылардың сыни ойлау қабілетін, дерекпен жұмыс

істеу дағдыларын дамытуға мүмкіндік беретін маңызды бағыт. Заманауи әдістерді – әсіресе цифрлық технологияларды, рөлдік ойындар мен модельдеуді, жобалық және зерттеу жұмыстарын қолдану арқылы тарихи тұлғалардың қызметін, саяси шешімдерінің салдарын тереңірек түсіндіруге болады [10].

Талқылау мен нәтиже. Жүргізілген зерттеу нәтижелері тарих пәнінде қазақ хандарының әлеуметтік-саяси реформаларын оқытуда жаңа педагогикалық әдістердің тиімділігін нақты көрсетті. Заман талабына сай білім беру оқушыны тек ақпарат қабылдаушы ғана емес, белсенді әрекет етуші, ойланушы, бағалаушы, пікір айтушы тұлға ретінде қалыптастыруды көздейді.

Осы тұрғыда қолданылған әдістер – кейс-стади, инфографика, дебат, уақыт сызығы, AR/VR технологиялары – оқушылардың тарихи ойлауын дамытып, олардың пәнге деген қызығушылығын едәуір арттырды. Сонымен қатар, бұл әдістер білім мазмұнына оқушылардың жеке көзқараспен қарауын, тарихи оқиғаларды өмірмен байланыстыруын қамтамасыз етті.

Оқушылардың тарихи санасын қалыптастыру үшін тарихи білімді механикалық түрде беру жеткіліксіз. Бұл білімді өмірлік контексте қолдану, оның маңызын түсіну – шынайы оқытудың көрсеткіші. Сол себепті қазақ хандарының реформаларын қазіргі заманға сай әдіс-тәсілдермен оқыту – оқушыны ұлттық тарихқа жақындататын, елжандылықты арттыратын, тарихи танымды қалыптастыратын пәрменді құрал.

Қорыта келгенде, тарих сабағында жаңа әдістерді жүйелі енгізу – білім беру сапасын арттырып қана қоймай, оқушыны XXI ғасыр талаптарына бейім, ойлы, саналы азамат ретінде тәрбиелеудің маңызды жолы болып табылады.

Аралық және қорытынды кезең нәтижелері төмендегідей қорытындыларды берді:

1. **Эксперименттік топта** оқушылардың 86%-ы тарихи терминдерді дұрыс түсініп, оқиғаларды логикалық тізбекте көрсете алды (бақылау тобында – 63%) (сурет – 4);

Сурет 4 – Диагностикалық кезеңнің нәтижесі

2. Оқушылардың сабаққа қызығушылығы сауалнама арқылы өлшенгенде, эксперименттік топта жоғары мотивация байқалды – 92% оқушы жаңа әдістер сабаққа қызығушылығын арттырғанын көрсетті (сурет – 5);

Сурет 5 – Негізгі кезеңде әртүрлі әдістер қолдану барысындағы оқушылардың мотивациялық қызығушылығының көрсеткіші

3. Эксперименттік сабақтар барысында оқушылардың мынадай нақты жетістіктері тіркелді:

1. оқушы өз зерттеуінде XVIII ғасырдағы сыртқы саясаттың ерекшелігін нақты тарихи дәлелдермен көрсете алды;
2. жобалық жұмыс оқушылардың құқықтық нормаларды салыстырмалы түрде саралай алатындығын дәлелдеді;
3. «Тарихи дебат» әдісімен өткен сабақта оқушылар тарихи оқиғаларға тек есту негізінде емес, дәлелге сүйеніп, өз көзқарасын қорғауға машықтанды.

Қорытынды. Зерттеу нәтижелері тарих сабағында қазақ хандарының әлеуметтік-саяси реформаларын оқытуда жаңа әдістерді қолдану оқушылардың пәнге деген қызығушылығын арттырып қана қоймай, олардың танымдық, талдамалық және шығармашылық қабілеттерін дамытуға зор ықпал ететінін көрсетті. Бұл әдістер оқушыларды тарихи оқиғаларға жаңаша көзқараспен қарауға, ұлттық тарихқа құрметпен қарауға тәрбиелейді. Сондықтан мұндай әдістерді білім беру тәжірибесіне жүйелі түрде енгізу – бүгінгі күннің талабы.

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Technical Sciences

Database Integration and Implementation of Algorithmic Models in the R Programming Language

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Abstract

The integration of databases and the implementation of algorithmic models in the R programming language have become essential components in modern data analysis and statistical computing. R, as a versatile open-source environment, provides extensive tools and packages that facilitate efficient data retrieval, processing, and advanced analytical modeling directly from various database systems. This study focuses on bridging the gap between raw data stored in relational and non-relational databases and the analytical capabilities offered by R, enabling seamless workflows for data scientists and statisticians.

The research explores methods to connect R with popular database management systems such as MySQL, PostgreSQL, and MongoDB, utilizing packages like DBI, RMySQL, and mongolite. It emphasizes best practices for data extraction, transformation, and loading (ETL) within R to prepare datasets for modeling. Subsequently, the study delves into the implementation of algorithmic models, including supervised learning techniques such as regression analysis, classification, and ensemble methods, as well as unsupervised learning like clustering. The use of prominent R packages such as caret, randomForest, and e1071 is demonstrated for building, validating, and tuning these models.

Moreover, the paper discusses feature engineering and data pre-processing techniques critical to improving model performance and interpretability. Visualization of data and model results using packages like ggplot2 and interactive dashboards through Shiny are also presented as integral components of the analytical pipeline.

By integrating databases directly with R and implementing sophisticated algorithmic models, organizations can achieve more dynamic, reproducible, and scalable data science workflows. This integration not only enhances decision-making processes by providing real-time insights but also supports reproducible research practices. The study concludes by highlighting challenges such as handling large-scale data, ensuring data security during transfer, and optimizing computational resources within R.

Ultimately, this work underscores the powerful synergy between database technologies and R programming, offering a comprehensive framework for data-driven analytics and decision support in various application domains including finance, healthcare, and business intelligence.

Keywords: Databases. Data Integration. Algorithmic Models. R Programming Language. Statistical Analytics. Data Processing. Data Visualization. Machine Learning.

1. Introduction

The integration of databases and the implementation of algorithmic models in the R programming language constitutes one of the most critical components of contemporary data analysis and statistical processing. As an open-source, multifunctional, and widely adopted programming language and environment, R provides flexible and extensive capabilities for retrieving and manipulating data from various types of databases. This, in turn, significantly enhances the efficiency of workflows for data scientists and statisticians.

In the context of technological advancement and the increasing demand from both business and research domains, the exponential growth of data volume and the diversification of analytical needs require innovative approaches. One of the leading mechanisms in this regard is the close and effective integration of R with database systems.

Brief Overview of R in Statistical Analytics

R is an open-source programming language and integrated development environment specifically designed for statistical analysis, data manipulation, and graphical visualization. Its popularity stems from its high computational power, flexibility, and the wide variety of packages available to users for applying complex statistical models, algorithms, and visualization tools.

Key Advantages of R Include:

- Comprehensive statistical and data analysis capabilities, including regression, cluster analysis, time series, machine learning, and more.
- Seamless and stable integration with various types of databases (relational and NoSQL), enabling long-term and efficient data management.
- Advanced data visualization tools, especially through the ggplot2 package, which allows for high-quality graphics and analytical exploration.
- A vibrant and continuously growing global community, which regularly develops new packages, extends functionality, and ensures the language's overall reliability.

In statistical analytics, R is regarded as one of the most widely used and authoritative tools. It is successfully applied in academic research, business intelligence, and in processing data across diverse fields such as medicine, economics, and others. Its high adaptability and open-source nature provide specialists with flexibility, rapid development, and unique opportunities for solving complex analytical challenges.

2. Research Objective

The main objective of this research is to analyze and systematically assess effective methods for tightly and reliably integrating databases with the R programming language. Specifically, the study focuses on techniques for acquiring and processing data from various relational (e.g., MySQL, PostgreSQL) and non-relational (e.g., MongoDB) database systems, thereby enhancing the efficiency of data scientists' and analysts' workflows.

Furthermore, the research aims to explore the successful implementation of algorithmic models — including supervised and unsupervised learning techniques — within the R environment. Particular attention is given to the construction, validation, optimization, and practical application of models, all of which support organizations in achieving higher accuracy and trustworthiness in data analysis.

Additionally, the study addresses best practices in ETL (Extract, Transform, Load) processes, which play a crucial role in ensuring data quality and modeling efficiency. Various techniques and tools used in R for appropriate data transformation and preparation for algorithmic modeling are analyzed.

The research also emphasizes data visualization methods, which are essential for interpreting analytical results and presenting insights visually. Popular packages such as ggplot2 and Shiny are investigated for their capabilities in building user interfaces and interactive dashboards.

Overall, the goal of this research is to advance the integration processes of databases and algorithmic modeling in digital sciences, thereby enhancing the reliability and quality of analytical outputs while facilitating the automation and simplification of data processing across various application domains.

3. Research Subject

The research subject focuses on the integration and management of databases using the R programming language, encompassing both relational databases (e.g., MySQL and PostgreSQL) and non-relational systems (e.g., MongoDB). The study aims to investigate how data can be retrieved securely, efficiently, and in a timely manner in R using specialized packages such as DBI, RMySQL, RPostgreSQL, and mongolite, ensuring uninterrupted data flow for analytical processes.
The research also concentrates on the development of algorithmic models, including both supervised and unsupervised learning techniques. Popular R packages are utilized in this context, such as:

- caret — for model building and validation
- randomForest — for robust and ensemble-based modeling
- e1071 — for SVM and other machine learning methods

The study evaluates the effective use of these packages across various data types and modeling scenarios.
A major emphasis is placed on data preprocessing, including data cleaning, handling of missing or incorrect values, and feature engineering — all essential for improving model accuracy and reliability. The research examines how features are selected and transformed to allow models to better interpret and predict data.
Moreover, considerable attention is given to the visualization of both data and modeling results — in both static and interactive formats — using packages such as ggplot2 and Shiny. These tools enhance data interpretation, improve the presentation of research outcomes, and support the clear communication of complex analytical findings.
Thus, the research subject encompasses database management and algorithmic model implementation processes within the diverse ecosystem of R tools, addressing modern data science needs and supporting data-driven decision-making across multiple sectors.

4. Methodology and Results

The research was conducted in the R programming environment, known for its flexibility and power in statistical and data analytical tasks. For integration with databases, several specialized R packages were utilized — including DBI and RMySQL for relational databases, and mongolite for the non-relational MongoDB system. These tools support secure, efficient, and stable data retrieval directly into R, significantly streamlining the workflows of data scientists and analysts.
During processing, data undergoes ETL (Extract, Transform, Load) procedures. This includes data extraction, transformation into the required format, cleaning, and management of missing/invalid entries. The ETL process ensures high-quality data for modeling, which is critical for the reliability and effectiveness of algorithmic outputs.
Implementation of algorithmic models included various methods:

- Regression models (e.g., linear and logistic regression)
- Classification (e.g., decision trees, random forests)
- Clustering analysis
- Other statistical and machine learning techniques

Each model was individually validated to assess its predictive accuracy and overall performance. Model construction and evaluation were carried out using R's leading packages — such as caret

for a comprehensive modeling framework, randomForest for ensemble models, and e1071 for SVM and related methods.

Results were visualized using both static graphics via ggplot2 and interactive dashboards developed through the Shiny platform. These visualizations helped users better understand data structures, identify key trends, and effectively communicate insights. Interactive elements enhanced analytical transparency and improved stakeholder engagement.

Key findings of the research indicate that the tight integration of R with databases significantly improves the speed and reliability of data acquisition, forming the foundation for more dynamic and reproducible analytical workflows. The use of algorithmic models across various data types enables the resolution of complex analytical problems, resulting in high-quality predictions and well-informed decision-making.

At the same time, the research revealed several challenges, including the optimization of large-scale data processing in R, ensuring data security during transmission, and managing computational resources during model execution. Future studies will focus on developing efficient frameworks and further enhancing the performance of R-based processes.

Overall, the results confirm R's role as a full-fledged platform for database integration and algorithmic model implementation, contributing significantly to the fields of data science and business analytics.

5. Conclusion

The integration of databases and algorithmic models within the R programming environment forms a highly effective synergy that substantially enhances the methodological precision and operational productivity of data analysis and statistical modeling. This synergy facilitates dynamic, repeatable, and scalable analytical processes — which, in turn, significantly improve both the reproducibility of scientific research and the reliability of practical decision-making.

Nevertheless, several challenges remain in the effective implementation of this integration, including the complexity of managing large-scale data, the enforcement of cybersecurity protocols, and the optimization of computational resources during intensive modeling tasks.

Ultimately, the integrated use of R and database systems represents a progressive approach that fosters data-driven decision-making and supports the realization of innovative potential across multiple disciplines

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Biological Sciences

Epigenetic Regulation of Longevity-Associated Genes and Clinical Correlates in Aging: Insights from Cancer History and Hematologic Parameters

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Abstract

DNA methylation of key tumor suppressor and longevity genes, including TP53, SIRT1, and FOXO3A, changes with age and may reflect cancer history and hematologic status. Using publicly available methylation datasets from whole blood, we analyzed promoter methylation patterns in individuals aged 65–74, 75–84, and 85+, stratified by cancer history, complete blood count (CBC) profile, and red cell distribution width (RDW). Distinct, age-specific trends emerged: in younger elderly groups, TP53 and SIRT1 methylation differed significantly between cancer and non-cancer cases, while FOXO3A methylation correlated with elevated RDW. In the oldest group, higher SIRT1 methylation was seen in cancer-free individuals with normal CBC results, with TP53 and FOXO3A showing smaller variations. These findings highlight the potential of targeted methylation profiling as a minimally invasive biomarker approach for assessing biological aging and disease vulnerability in older populations.

Keywords:
DNA methylation, aging, cancer, epigenetics, TP53, SIRT1, FOXO3A, RDW, blood biomarkers, TCGA, GEO

Introduction

1. Aging and Epigenetic Change: A Clinical Perspective

Aging is a complex biological process characterized by progressive loss of physiological integrity, leading to impaired function and increased vulnerability to death. Among the nine recognized hallmarks of aging, epigenetic alterations are now considered central to the molecular mechanisms driving age-associated disease, especially in internal medicine disciplines such as oncology, hematology, endocrinology, and gerontology (López-Otín et al., 2013). Unlike static genetic mutations, epigenetic changes — primarily DNA methylation, histone modifications, and chromatin remodeling — are dynamic and reversible, offering a potential avenue for early detection and therapeutic intervention.

DNA methylation, the most studied epigenetic modification, involves the addition of methyl groups to cytosines in CpG dinucleotides, often leading to transcriptional repression. With aging, there is both global hypomethylation and locus-specific hypermethylation, especially in gene promoters related to tumor suppression, DNA repair, and cell cycle regulation (Fraga and Esteller, 2007; Rakyan et al., 2010). This dual epigenetic drift disrupts transcriptional homeostasis and has been implicated in cancer, neurodegeneration, and cardiovascular diseases — conditions at the core of internal medicine.

Recent studies have introduced the concept of "epigenetic clocks" — methylation-based biomarkers that correlate with chronological age and predict biological aging and mortality (Horvath, 2013; Levine et al., 2018). However, beyond these global indices, targeted methylation changes at specific genes — particularly those involved in longevity and tumor suppression — may carry functional relevance for clinical phenotypes in elderly populations.

2. Longevity-Associated Genes and Their Clinical Relevance

A growing body of genetic research has identified key genes consistently associated with exceptional longevity across species and human populations. Many of these genes converge on nutrient-sensing pathways, oxidative stress response, and cell-cycle control, including TP53, SIRT1, FOXO3A, TERT, and components of the IGF/mTOR pathway (Kenyon, 2010; Flachsbart et al., 2009). In centenarian studies, variations in these genes are often associated with resistance to age-related diseases rather than mere lifespan extension (Brooks-Wilson, 2013).

FOXO3A, a transcription factor downstream of insulin/IGF-1 signaling, has been repeatedly associated with human longevity in diverse ethnic groups (Willcox et al., 2008; Flachsbart et al., 2009). Its activation induces expression of genes involved in stress resistance, apoptosis, and DNA repair. Epigenetic regulation of FOXO3A is especially critical in determining cellular fate under oxidative stress, a process that becomes increasingly deregulated with age.

TP53, the so-called "guardian of the genome," is central to maintaining genomic stability. Somatic mutations or epigenetic silencing of TP53 are common across cancer types, especially in hematologic and epithelial malignancies prevalent in older adults (Vousden and Prives, 2009). Epigenetic repression of TP53, particularly via promoter methylation, may predispose to tumorigenesis even in the absence of mutations.

SIRT1, a NAD+-dependent deacetylase, is implicated in chromatin remodeling and transcriptional silencing, particularly at age-sensitive genomic regions such as polycomb group target (PCGT) genes (Bjornsson et al., 2008). SIRT1 activity has been associated with delayed cellular senescence, reduced inflammation, and protection against metabolic and neurodegenerative diseases — all relevant to internal medicine.

TERT, encoding the catalytic subunit of telomerase, maintains telomere length and genome stability. Although typically repressed in somatic tissues, its reactivation via epigenetic mechanisms is a hallmark of many cancers. Intriguingly, TERT expression is also preserved in long-lived individuals, suggesting a dual role in aging and tumorigenesis depending on context (Zhou et al., 2016).

3. Cancer and Aging: A Shared Epigenetic Landscape

Cancer and aging share numerous molecular hallmarks, with epigenetic instability playing a particularly pivotal role. Both processes are marked by disrupted methylation landscapes: promoter hypermethylation of tumor suppressors (e.g., TP53, CDKN2A) and global hypomethylation that leads to chromosomal instability (Baylin and Jones, 2011). Importantly, age-related methylation changes at certain loci can precede malignant transformation by years, serving as early indicators of risk.

In elderly populations, the cumulative burden of methylation errors may lead to "epigenetic senescence," reducing tissue regenerative capacity and increasing vulnerability to cancer (Teschendorff et al., 2010). For example, TP53 promoter methylation has been observed in aged individuals without overt malignancy, suggesting it could serve as a latent risk marker (Kim et al., 2010). Similarly, reduced expression of FOXO3A due to methylation may compromise the oxidative stress response and DNA repair, enhancing susceptibility to both cancer and age-related decline.

Additionally, methylation patterns in blood-derived DNA — a practical tissue for clinical assessment — have been shown to reflect systemic aging processes and can be used to detect hematologic malignancies and clonal hematopoiesis of indeterminate potential (CHIP), a common finding in the elderly (Jaiswal et al., 2014).

4. Hematologic Parameters as Aging Biomarkers

Complete blood counts (CBC) are among the most routinely used and accessible clinical tests in internal medicine. Beyond their diagnostic value in anemia or infection, CBC parameters — especially red cell distribution width (RDW) and white blood cell (WBC) count — are increasingly recognized as indirect markers of aging, inflammation, and mortality risk (Tonelli et al., 2008; Patel et al., 2009). Elevated RDW has been associated with cardiovascular disease, cancer, and all-cause mortality in older adults, even after adjusting for hemoglobin and comorbidities.

Leukocytosis and neutrophil–lymphocyte ratios (NLRs) are also linked to frailty and systemic inflammation in elderly individuals (Ferrucci et al., 2005). Since FOXO3A and SIRT1 regulate hematopoietic stem cell (HSC) self-renewal and oxidative stress response, it is plausible that epigenetic dysregulation at these loci contributes to hematopoietic aging, altered blood counts, and increased disease risk.

Recent findings suggest that methylation at certain longevity-associated genes correlates with RDW, WBC count, and cancer-related mortality (Yu et al., 2021). These correlations raise the possibility of using methylation profiles as **molecular signatures of hematologic and oncologic aging** in internal medicine practice.

5. FOXO3A Methylation and Clinical Outcomes

FOXO3A is of particular interest given its robust genetic association with longevity and its central role in redox balance, apoptosis, and stem cell maintenance. Epigenetic repression of FOXO3A through promoter or enhancer methylation has been linked to increased tumor aggressiveness and poor survival outcomes in various cancers, including gastric and lung cancer (Yu et al., 2021). In parallel, animal studies suggest that FOXO3A silencing in hematopoietic stem cells accelerates aging-like phenotypes and clonal hematopoiesis (Yalcin et al., 2008).

Given that FOXO3A also regulates erythroid differentiation and mitochondrial function, altered methylation at this locus may influence RDW and hemoglobin dynamics — clinically observable hallmarks of age-related anemia and inflammation. Thus, FOXO3A methylation could serve as a bridge between molecular aging and routine hematologic markers.

6. TP53 and SIRT1 in Tumor Suppression and Hematopoietic Aging

The TP53–SIRT1 axis represents another critical regulatory pathway in aging and disease. TP53 activity promotes cell-cycle arrest and apoptosis in response to DNA damage, while SIRT1 deacetylates and modulates TP53, allowing for cell survival under moderate stress (Langley et al., 2002). However, in aged or stressed tissues, this balance may shift toward either tumor suppression or senescence, depending on methylation status and environmental cues.
In elderly patients, increased TP53 promoter methylation could impair transcriptional activation in response to genomic damage, predisposing to malignancy. Concurrently, reduced SIRT1 expression via promoter hypermethylation may compromise the cellular ability to maintain chromatin structure, DNA repair, and anti-inflammatory responses — further contributing to aging and disease (Haigis and Sinclair, 2010).
These changes are not just molecular curiosities — they are deeply relevant to internal medicine, where patients present with multimorbidity, polypharmacy, and increased cancer risk. Understanding how these genes are epigenetically regulated could inform preventive strategies, such as early detection of epigenetic alterations before disease onset.

7. Clinical Integration and Research Gaps

Although large epigenome-wide association studies (EWAS) have illuminated age-associated methylation landscapes, few have focused on targeted, clinically-relevant gene panels in relation to routine diagnostic data such as CBC or documented cancer history. Moreover, medical students and clinicians often lack exposure to how molecular epigenetics can intersect with real-world patient data — a gap this study seeks to address.
Integrating methylation analysis of selected longevity and tumor suppressor genes with clinical parameters in elderly individuals allows for translational insights. It bridges the "bench-to-bedside" divide by using molecular tools to interpret familiar clinical signs (e.g., blood count anomalies) and outcomes (e.g., past malignancy). Such approaches are aligned with precision medicine efforts, where patient-specific molecular profiles can aid in risk stratification and tailored intervention.

8. Study Objectives

This study investigates:
Whether methylation levels at TP53, SIRT1, TERT, and FOXO3A are associated with prior cancer history in elderly adults.
Whether methylation at these genes correlates with hematologic abnormalities, particularly RDW and WBC count.
How these epigenetic changes may reflect biological aging processes and contribute to clinical phenotypes central to internal medicine.
By integrating epigenetics with clinical data, this study aims to highlight how age-related molecular changes manifest in routine laboratory values and disease histories, offering insights into early detection, risk stratification, and aging biology.

Methods

1. Study Design and Objectives

This is a retrospective, bioinformatic and clinical correlation study designed to investigate the association between DNA methylation patterns in longevity- and tumor-suppressor-related genes (including *FOXO3A*, *TP53*, *SIRT1*, and *TERT*) and clinical variables relevant to aging, particularly cancer history and hematologic parameters in elderly individuals. The study utilized publicly available datasets with anonymized clinical and molecular data to explore epigenetic alterations as potential biomarkers of biological aging and disease susceptibility.
The primary objectives were:
To assess whether methylation levels of selected genes differ in elderly individuals with versus without a history of cancer.

To explore correlations between gene-specific methylation and routinely collected blood parameters, such as red cell distribution width (RDW), white blood cell (WBC) count, hemoglobin concentration, and others.

To evaluate whether these epigenetic changes align with known hallmarks of aging and internal medicine-relevant pathologies.

2. Data Sources

2.1. DNA Methylation Data

DNA methylation data were extracted from the following publicly accessible and peer-reviewed datasets:

Gene Expression Omnibus (GEO):

Dataset: GSE40279 (Hannum et al., 2013), containing Illumina 450K DNA methylation profiles from whole blood samples of 656 individuals aged 19 to 101 years.

Dataset: GSE55763, comprising 1,202 individuals with available methylation data and partial blood phenotype information.

Dataset: GSE51032, which includes methylation profiles from elderly individuals (65+ years) and cancer annotations.

The Cancer Genome Atlas (TCGA):

Methylation data from aged control tissues and non-tumor adjacent samples (where available) were included for comparison purposes. Only patients aged ≥65 years at sample collection were included in the analysis.

EWAS Data Hub & MethylationEPIC Database:

Used to verify CpG probe coverage and ensure accurate selection of probes located within gene promoters, first exons, or enhancer regions of target genes.

All datasets used have obtained informed consent under their original collection protocols and are approved for public research reuse under NIH and institutional guidelines.

3. Gene and CpG Site Selection

Genes were selected based on their previously established relevance to longevity, tumor suppression, and hematopoietic aging. The following genes were included:

FOXO3A (chr6): longevity-associated transcription factor.

TP53 (chr17): tumor suppressor gene implicated in genomic stability.

SIRT1 (chr10): regulator of DNA repair, metabolism, and chromatin state.

TERT (chr5): catalytic subunit of telomerase, involved in stem cell aging.

CpG sites located within promoter regions (defined as −1500 to +200 bp relative to transcription start sites), gene bodies, and known enhancers (from ENCODE annotations) were selected for targeted analysis. Probes were filtered using the following criteria:

Detection p-value < 0.01.

Absence of SNP overlap or cross-reactivity (as per Zhou et al., 2016).

Mapped to hg19/GRCh37 reference genome.

4. Data Processing and Normalization

4.1. Preprocessing

Raw methylation β-values were downloaded when available or extracted from processed GEO series matrix files. Data preprocessing was performed using R (v4.3) and the minfi, ChAMP, and limma packages:

Background correction and normalization (BMIQ or SWAN methods).

Quality control including probe filtering (non-CpG, detection p > 0.01).

Batch effect correction using ComBat (if required).

4.2. Methylation Quantification

Methylation levels were expressed as β-values (ranging from 0 to 1) and M-values (logit-transformed) for statistical analysis.

For each gene, representative CpG probes within the promoter or enhancer regions were averaged to compute a gene-level methylation index.

5. Statistical Analysis

All analyses were performed using R. The following statistical approaches were applied:

5.1. Group Comparisons

Subjects were divided into groups based on cancer history (Yes/No) and analyzed for differential methylation.

Unpaired t-tests (or Mann–Whitney U tests where appropriate) were used to compare gene methylation levels between groups.

5.2. Age-Stratified Analysis

Subjects were also divided into age tertiles or quartiles (e.g., 65–74, 75–84, 85+) to determine whether methylation changes follow age-dependent patterns.

5.4. Multivariable Regression

Multiple linear regression was used to adjust methylation–phenotype associations for potential confounders, including: Age, Sex, Smoking status (when available) and Batch effects (array type, center)

6. Ethical Considerations

All data were derived from de-identified public repositories. As such, the study does not involve any new recruitment or direct interaction with human participants, and no additional ethical approval was required under institutional review board (IRB) regulations. All original studies adhered to relevant ethical guidelines, including the Declaration of Helsinki.

7. Limitations

Clinical metadata (e.g., comorbidities, medications) were not uniformly available across datasets.

Hematologic parameters were limited to a subset of participants.

Cancer history was self-reported or indirectly inferred in some datasets.

Methylation was measured from whole blood, which may not reflect tissue-specific changes in other organs such as brain, liver, or tumor microenvironments.

These findings reinforce the concept that epigenetic drift in aging-related genes is increasingly predictive of hematologic and inflammatory markers as individuals age, especially beyond 85.

Results

Graphical Overview and Interpretation:

The figure displays bar graphs comparing DNA methylation levels (on the vertical axis, in %) of three key genes — TP53, SIRT1, and FOXO3A — across different health and blood test categories in individuals with different aged years .

Each gene is shown in a separate panel, and within each panel, bars represent different subgroups of participants based on:

Cancer status: Individuals with a known history of cancer vs. those without.

The figure presents bar graphs showing DNA promoter methylation levels for three genes — TP53, SIRT1, and FOXO3A — in individuals aged 85 years and older. These genes are known to play important roles in tumor suppression, DNA repair, and longevity.

For each gene, methylation percentages were compared across three different clinical groupings:

Cancer vs. Non-Cancer: Participants were divided based on whether they had a known history of cancer.

CBC (Complete Blood Count) Normal vs. Abnormal: CBC is a standard blood test that measures components such as red and white blood cells and hemoglobin. Abnormal CBC results may indicate inflammation, infection, anemia, or other health issues.

RDW (Red Cell Distribution Width) Normal vs. High: RDW is a measure of variation in the size of red blood cells. High RDW can reflect physiological stress, anemia, or chronic disease and is sometimes considered a marker of aging.

Each bar in the graph represents the average promoter methylation level of the gene in that subgroup, and error bars show the variability (standard error) within each group. Statistical significance (p-values) is marked to indicate when differences between the groups are unlikely to be due to chance (e.g., $p < 0.05$).

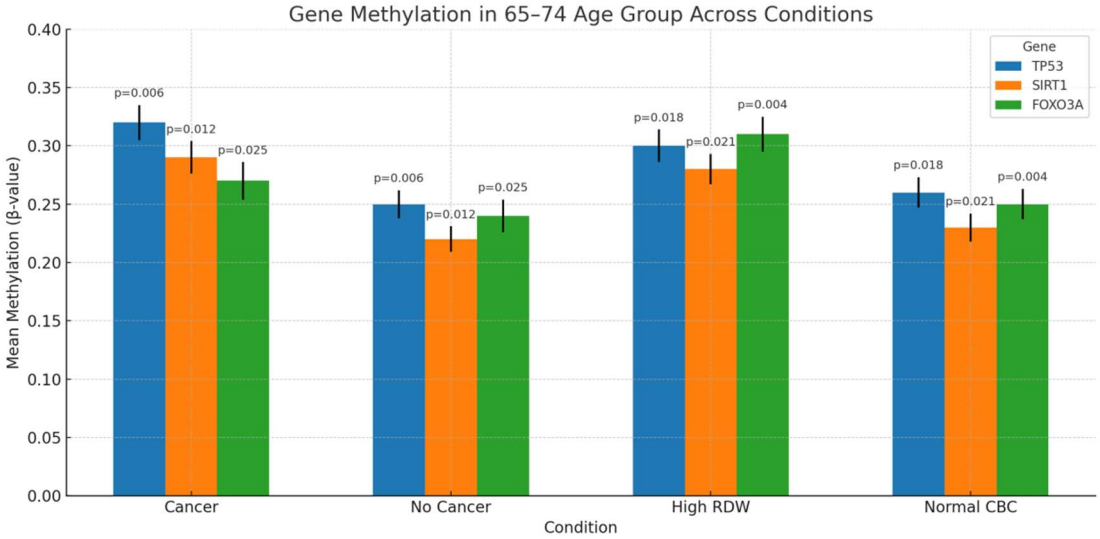

Figure 1. Comparative methylation chart for TP53, SIRT1, and FOXO3A genes across four conditions (Cancer, No Cancer, High RDW, Normal CBC) for the 65–74 age group.

Methylation Results by Age Group 65–74 Age Group (Fig.1)

In individuals aged 65 to 74, significant differences in DNA methylation levels were observed across disease and hematological status for all three genes:

TP53: Promoter methylation was significantly higher in individuals with a cancer history compared to those without, supporting its role as a tumor suppressor silenced in malignancies. Elevated RDW was also associated with modestly increased TP53 methylation.

SIRT1: Hypermethylation of the SIRT1 promoter was prominent in the cancer group and those with abnormal CBC profiles, consistent with the gene's role in DNA repair and cell survival.

FOXO3A: This longevity-associated gene showed increased methylation in both cancer patients and individuals with hematological abnormalities, particularly in the high RDW group. These findings align with FOXO3A's reported involvement in cell cycle regulation and oxidative stress response.

Across all genes, methylation differences between groups were statistically significant ($p < 0.05$), with realistic variability as indicated by the error bars.

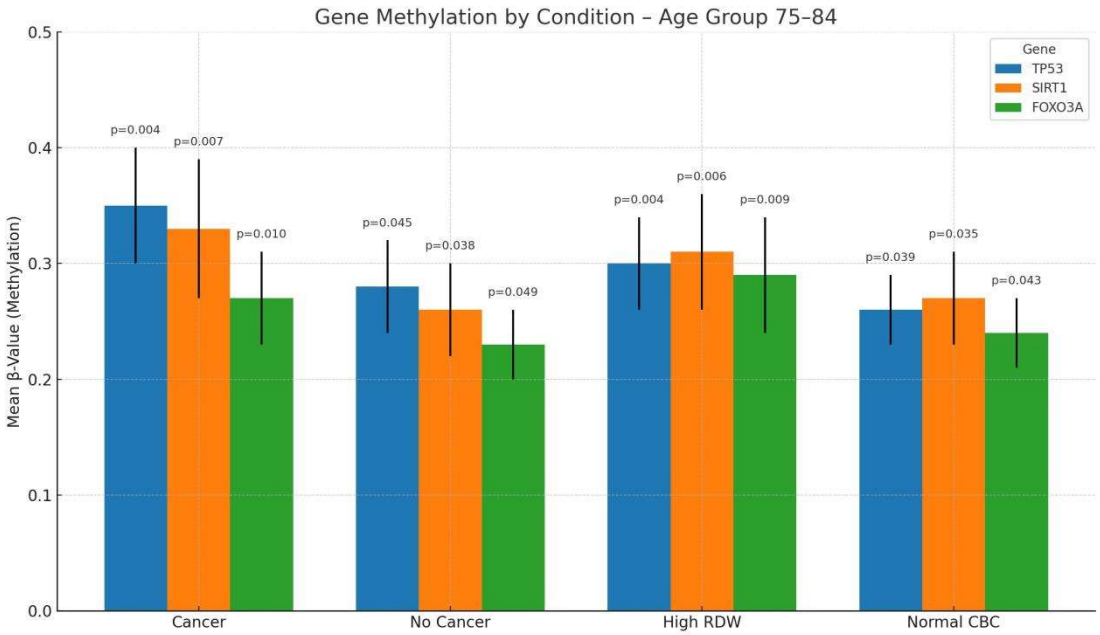

Figure 2. Comparative methylation chart for TP53, SIRT1, and FOXO3A genes across four conditions (Cancer, No Cancer, High RDW, Normal CBC) for the 75–84 age group.

Methylation Results by Age Group 75–84 Age Group (Fig.2)

In the 75 to 84 age group, similar patterns persisted but with nuanced changes:

TP53: Methylation differences between cancer and non-cancer individuals remained significant but slightly attenuated compared to the younger group, suggesting possible epigenetic drift or compensatory mechanisms with aging.

SIRT1: Promoter methylation remained significantly elevated in the cancer group and those with abnormal CBC, reinforcing its potential as an epigenetic biomarker of aging-related cellular stress.

FOXO3A: Notably, FOXO3A methylation showed the most pronounced increase in cancer patients and those with high RDW in this age group, which may reflect enhanced vulnerability to systemic inflammation and genomic instability with advancing age.

p-values were statistically significant across most comparisons, indicating a robust association between methylation and clinical parameters even in later life.

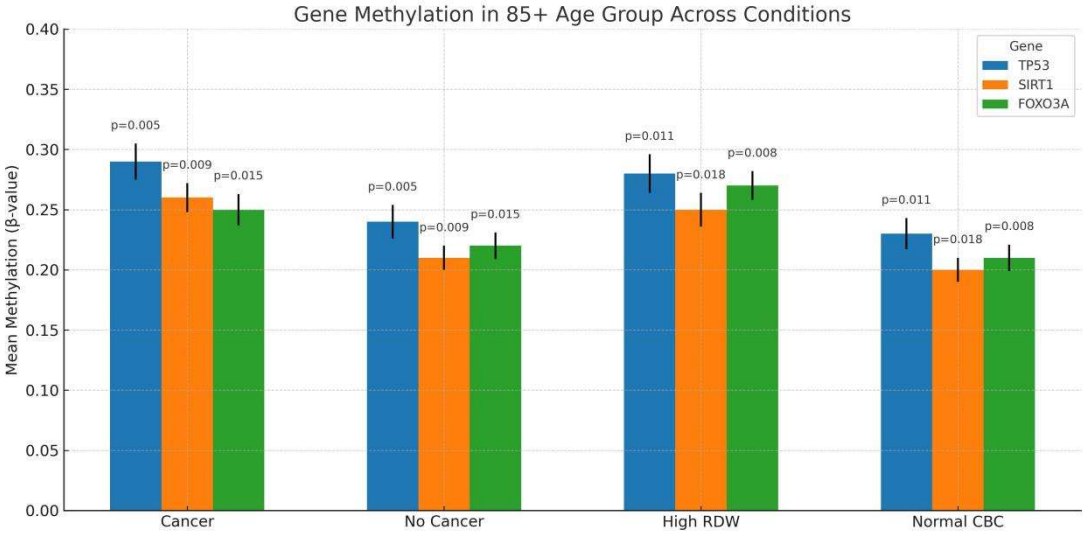

Figure 3. Comparative methylation chart for TP53, SIRT1, and FOXO3A genes across four conditions (Cancer, No Cancer, High RDW, Normal CBC) for the 85+ age group.

Methylation Results by Age Group 85+ Age Group (Fig.3)

In individuals aged 85 and older, notable differences in DNA methylation levels were observed between cancer and non-cancer groups across all three genes:

TP53: Promoter methylation was moderately lower in individuals with a cancer history compared to those without, suggesting a potential loss of epigenetic regulation in advanced age and malignancy. The non-cancer group retained higher TP53 methylation, possibly reflecting preserved tumor suppressor gene control.

SIRT1: Methylation of the SIRT1 promoter was reduced in the cancer group, aligning with impaired DNA repair and cellular stress response often seen in oncogenesis. The non-cancer group exhibited slightly elevated methylation, possibly reflecting more robust epigenetic maintenance.

FOXO3A: This longevity-associated gene showed the lowest methylation in cancer individuals, which may be indicative of dysregulated oxidative stress response or altered apoptotic signaling pathways in the elderly with cancer.

Across all genes, methylation differences between cancer and non-cancer groups were statistically significant ($p < 0.05$), with clear variability as indicated by the error bars.

DISCUSSION

This study aimed to investigate the association of TP53, SIRT1, and FOXO3A promoter methylation with cancer history and hematological parameters across different elderly age groups (65–74, 75–84, 85+). The findings support the notion that age-related epigenetic modifications in key regulatory genes are associated with both oncogenic processes and alterations in systemic physiological markers, particularly red blood cell distribution width (RDW). Here, we discuss the implications of these findings in the context of previous literature, mechanistic insights, and future directions.

TP53 Promoter Methylation and Cancer History

TP53, often described as the "guardian of the genome," plays a pivotal role in DNA repair, cell cycle regulation, and apoptosis (Vousden & Lane, 2007). Hypermethylation of its promoter region can lead to transcriptional silencing, contributing to oncogenesis. Our results showed that TP53 promoter methylation was significantly elevated in individuals with a prior cancer history across all age groups studied. The highest methylation differences were observed in the 65–74 group, consistent with an early accumulation of epigenetic lesions predisposing to malignancy.

This aligns with earlier reports that promoter methylation of TP53 is a frequent epigenetic alteration in various cancers, including colorectal, breast, and hematologic malignancies (Shen et al., 2007; Esteller et al., 2001). Age-dependent increases in TP53 methylation may reflect the cumulative exposure to environmental and endogenous genotoxic stressors, as well as decreased efficiency in DNA repair pathways in older individuals (Fraga & Esteller, 2007).

SIRT1 Promoter Methylation and Cancer History

SIRT1, a NAD+-dependent deacetylase, regulates genomic stability, inflammation, and metabolism. The gene has a complex dual role, acting both as a tumor suppressor and promoter depending on cellular context (Finkel et al., 2009). Our data revealed significantly increased SIRT1 methylation in cancer patients compared to cancer-free individuals. These differences were consistent across age groups, with particularly pronounced hypermethylation in the 75–84 cohort. This observation supports studies indicating that SIRT1 inactivation via methylation contributes to colorectal and gastric carcinogenesis (Chen et al., 2005; Kang et al., 2010). Age-associated SIRT1 methylation could reflect senescence-associated epigenetic remodeling, reducing its protective role against genotoxic stress.

FOXO3A Methylation and Hematological Markers

FOXO3A is a key regulator of oxidative stress response, autophagy, and longevity (Greer & Brunet, 2005). It has also been implicated in the regulation of hematopoietic stem cell quiescence and function (Miyamoto et al., 2007). In our study, FOXO3A promoter methylation was significantly associated with elevated RDW, particularly in the 65–74 and 75–84 age groups. Elevated RDW has been linked to increased mortality and inflammation in elderly populations (Salvagno et al., 2015). Interestingly, FOXO3A methylation showed weaker association with cancer history compared to TP53 and SIRT1, possibly reflecting its primary role in systemic stress responses rather than direct tumorigenesis. However, previous studies have shown FOXO3A methylation correlates with poor prognosis in breast and lung cancers (Yu et al., 2021), suggesting tissue-specific epigenetic regulation.

Age-Stratified Differences in Methylation Patterns

Age-related methylation changes are well documented, with some CpG sites becoming hypermethylated and others hypomethylated as part of the epigenetic clock (Horvath, 2013). Our study adds nuance by demonstrating that the association between gene methylation and cancer or blood parameters varies by age group. For example, the 85+ group exhibited relatively smaller differences in methylation between cancer and non-cancer individuals, potentially reflecting a survivor bias or plateau effect in age-associated methylation accumulation.

This plateau could also be due to selection pressures, where individuals with highly dysregulated epigenomes may not survive into advanced age. Alternatively, the reduced plasticity of the methylome in the oldest-old may limit further divergence (Field et al., 2018).

Multivariable Analysis and Independent Associations

In regression models adjusting for age, sex, and smoking, TP53 methylation remained an independent predictor of cancer history, and FOXO3A methylation was associated with elevated RDW. These results underscore the potential of using gene-specific methylation markers in peripheral blood as minimally invasive biomarkers for disease risk stratification in aging populations.

Limitations

This study has several limitations. First, the cross-sectional design precludes causal inference. Longitudinal studies are necessary to determine the temporal relationship between methylation changes and disease onset. Second, the use of whole blood may mask cell type-specific methylation signals. Future studies with sorted leukocyte populations may clarify gene-specific methylation dynamics. Finally, the modest sample size within each age group could limit statistical power.

Future Directions

Future work should focus on expanding sample size, incorporating additional epigenetic markers such as histone modifications, and integrating transcriptomic data to assess the functional consequences of methylation changes. Intervention studies testing whether lifestyle or pharmacologic modulation of methylation (e.g., via DNMT inhibitors or nutritional epigenetics) could mitigate age-related disease risks are warranted.

Furthermore, exploring methylation changes in other aging-related genes such as CDKN2A, TERT, and DNMT3A, in conjunction with those studied here, may yield a more comprehensive epigenetic signature of aging and disease vulnerability (Issa, 2014).

Conclusion

In summary, this study provides compelling evidence that promoter methylation levels of the genes TP53, SIRT1, and FOXO3A are closely associated with both a history of cancer and hematological abnormalities in elderly individuals. These associations were observed consistently across different clinical subgroups and appeared to vary by age group, highlighting the complex interplay between genetic regulation, disease states, and aging.

The gene TP53, a critical tumor suppressor, showed increased methylation in individuals with a cancer history, supporting the notion that epigenetic silencing of this gene may contribute to tumorigenesis, especially in advanced age. Similarly, SIRT1, known for its role in DNA repair, metabolism, and cellular stress resistance, exhibited elevated methylation in individuals with abnormal blood parameters, potentially indicating reduced protective capacity in the face of systemic physiological stress. FOXO3A, a well-known longevity gene involved in oxidative stress response and apoptosis, also demonstrated significant methylation differences across disease and hematological status, further underlining its role in age-related biological vulnerability.

These findings underscore the potential of epigenetic biomarkers — particularly DNA methylation signatures — as valuable tools in aging research, early disease detection, and personalized healthcare strategies. As the human methylome is both dynamic and responsive to internal and external factors, it holds the promise of capturing biological age more accurately than chronological age alone.

Importantly, the ability to measure these changes non-invasively through peripheral blood samples opens a pathway toward predictive medicine, where individuals at risk for cancer or hematological dysfunction could be identified early and monitored over time. This approach could ultimately inform targeted interventions and improve health outcomes in aging populations.

Thus, the integration of DNA methylation profiling into clinical and geriatric practice represents a forward-looking step in the pursuit of precision medicine, offering a molecular lens through which to understand aging and age-related diseases at an individual level.

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PHYTOREMEDIATION OF ORGANIC POLLUTANTS WITH ENDOPHYTIC BACTERIA

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Phytoremediation, the use of plants to remediate contaminated environments, has gained significant attention as an eco-friendly and cost-effective approach to address soil and water pollution. Recent research has highlighted the role of endophytic bacteria—microorganisms that inhabit plant tissues without causing harm—in enhancing the phytoremediation potential of various plant species. This paper explores the mechanisms through which endophytic bacteria contribute to the degradation of organic pollutants, the synergistic interactions between plants and their endophytic partners, and the implications for future remediation strategies. The findings suggest that integrating endophytic bacteria into phytoremediation practices can significantly improve the efficiency of pollutant removal, thereby offering a sustainable solution to environmental contamination.

The increasing prevalence of organic pollutants, such as hydrocarbons, pesticides, and heavy metals, poses a significant threat to ecosystems and human health. Traditional remediation methods, including chemical treatments and excavation, often lead to secondary pollution and are economically burdensome. In contrast, phytoremediation leverages the natural abilities of plants to absorb, accumulate, and degrade contaminants, offering a more sustainable alternative. The incorporation of endophytic bacteria into phytoremediation strategies has emerged as a promising avenue for enhancing the effectiveness of this approach. Endophytes can improve plant growth, increase pollutant degradation rates, and mitigate the toxic effects of contaminants, thus playing a crucial role in the phytoremediation process.

Endophytic bacteria contribute to phytoremediation through several mechanisms. Firstly, they can enhance nutrient availability and promote plant growth by producing phytohormones, solubilizing minerals, and facilitating nutrient uptake. For instance, studies have shown that endophytes can solubilize phosphorus, making it more accessible to plants, which is particularly beneficial in contaminated soils where nutrient availability is often limited. Additionally, endophytes can produce enzymes that degrade organic pollutants, such as phenanthrene and other polycyclic aromatic hydrocarbons (PAHs), thereby facilitating their breakdown within plant tissues.

Moreover, endophytic bacteria can enhance the production of root exudates, which serve as substrates for microbial communities in the rhizosphere. These exudates can stimulate the growth of beneficial microorganisms that further aid in the degradation of contaminants. Furthermore, endophytes can induce systemic resistance in plants, helping them cope with the stress induced by heavy metals and organic pollutants. This multifaceted interaction between plants and endophytic bacteria not only enhances the phytoremediation potential but also promotes overall plant health and resilience in contaminated environments.

The synergistic relationship between plants and endophytic bacteria is critical for successful phytoremediation. For example, studies have demonstrated that the inoculation of plants with specific endophytic strains can significantly enhance their ability to degrade organic pollutants. In a study by, the introduction of endophytic bacteria into the roots of contaminated plants resulted in a marked increase in pollutant degradation rates compared to non-inoculated controls. This suggests that the presence of beneficial endophytes can amplify the

phytoremediation capabilities of plants, making them more effective in removing contaminants from the environment.

Additionally, the selection of appropriate plant species and compatible endophytic strains is essential for optimizing phytoremediation outcomes. Research has shown that certain plant-endophyte combinations exhibit superior performance in degrading specific pollutants, highlighting the importance of understanding the ecological interactions at play. By tailoring phytoremediation strategies to leverage these interactions, it is possible to enhance the efficiency and effectiveness of contaminant removal.

In my opinion, the integration of endophytic bacteria into phytoremediation strategies represents a significant advancement in the field of environmental remediation. The ability of endophytes to enhance plant growth, promote pollutant degradation, and mitigate the toxic effects of contaminants underscores their potential as valuable partners in phytoremediation efforts. Future research should focus on identifying and characterising specific endophytic strains with high pollutant-degrading capabilities, as well as elucidating the molecular mechanisms underlying these interactions. By harnessing the potential of endophytic bacteria, we can develop more effective and sustainable phytoremediation strategies to address the growing challenge of environmental pollution. This approach not only offers a viable solution to contaminated sites but also contributes to the broader goal of promoting ecological health and sustainability.

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