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Cybersecurity and Online Education – Risks and Solutions

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Abstract: The swift proliferation of online education has transformed learning, providing accessibility, flexibility, and creativity. This transition has also engendered considerable cybersecurity threats, encompassing data breaches, identity theft, phishing schemes, and privacy issues. As educational institutions increasingly depend on digital platforms and cloud-based systems, they become attractive targets for cyber threats. This study examines the principal cybersecurity threats in e-learning settings, including illegal data access, malware infection, and ethical issues related to student surveillance. It also evaluates strategies for enhancing online education security, such as multi-factor authentication (MFA), artificial intelligence-based threat detection, blockchain for credential verification, and extensive regulatory frameworks. The discussion encompasses the significance of global cybersecurity frameworks, ethical data management, and digital literacy in safeguarding online learning. The study indicates that a comprehensive strategy integrating technology innovations, institutional regulations, and cybersecurity education is vital for establishing a secure, resilient, and privacy-aware online education environment.

***Keywords**: Cybersecurity, online education, digital privacy, data protection, cyber threats, e-learning security, artificial intelligence in cybersecurity, blockchain in education, regulatory frameworks, cyber literacy*

1. INTRODUCTION

In the digital era, cybersecurity has emerged as a critical issue, especially in online education. Cybersecurity encompasses the safeguarding of networks, systems, and data from cyber threats, including hacking, malware, and data breaches. In the realm of education, cybersecurity is crucial for protecting student data, academic records, and institutional systems from unwanted access. With the growing transition of educational institutions to digital platforms, the necessity for robust cybersecurity measures has intensified to avert identity theft, data breaches, and cyberattacks (Rahman et al., 2020).

The swift expansion of e-learning has rendered education more accessible and adaptable, enabling students and educators to engage from any location globally. The proliferation of digital education has heightened the potential of cyber threats, as learning management systems (LMS), cloud storage, and online examinations necessitate the interchange of sensitive personal information. In the absence of adequate security measures, these platforms are susceptible to cybercriminal operations, impacting both students and educational institutions. With the increasing adoption of remote learning by schools and universities, safeguarding data privacy and protection has emerged as a critical necessity (Bandara, Ioras, & Maher, 2014).

Online education offers various advantages but also poses significant cybersecurity threats, such as data breaches, identity theft, and privacy infringements. Cybercriminals frequently exploit inadequate security protocols, attacking students and educators via phishing schemes, ransomware, and social engineering strategies. Mitigating these threats necessitates a comprehensive cybersecurity plan that integrates sophisticated security technologies, ethical considerations, and regulatory frameworks. This paper analyzes

the cybersecurity threats in online education, investigates viable solutions, and deliberates future plans for maintaining a secure digital learning environment. (Catota, Morgan, & Sicker, 2019).

2. THE CYBERSECURITY RISKS IN ONLINE EDUCATION

Data Privacy and Student Information Security

One of the major cybersecurity concerns in online education is data privacy and the security of student information. Online learning platforms collect vast amounts of personal data, including student names, email addresses, academic records, and even biometric data in some cases. This information is stored in centralized databases, making it a prime target for cybercriminals. Hackers can exploit weak security protocols to gain unauthorized access to these systems, leading to data breaches that compromise sensitive student information (Alwi & Fan, 2010).

The risks associated with poor data security include unauthorized access, identity theft, and data leaks, which can have long-term consequences for students and educational institutions. In some cases, stolen student data is sold on the dark web, leading to fraudulent activities and reputational damage for universities and schools. Additionally, cybercriminals may manipulate or delete academic records, disrupting students' academic progress. Without proper security measures, institutions risk exposing students to privacy violations and cyber exploitation (Pardo & Siemens, 2014).

To mitigate these risks, strong encryption and secure authentication methods must be implemented across all online learning platforms. End-to-end encryption ensures that data remains secure during transmission, while multi-factor authentication (MFA) adds an extra layer of protection against unauthorized access. Institutions should also adopt zero-trust security models, which require continuous verification of users attempting to access digital learning environments. By integrating robust cybersecurity frameworks, educational institutions can protect student information and create a safer online learning experience (Weippl, 2005).

Cyber Threats Targeting E-Learning Systems

As online education continues to expand, so do the cyber threats targeting e-learning platforms. Educational institutions are increasingly vulnerable to various forms of cyberattacks, including phishing, malware, and ransomware, which exploit security weaknesses in digital learning environments. These attacks not only compromise student and faculty data but also disrupt the learning process, causing financial and reputational damage to institutions (Cabaj et al., 2018).

One of the most common threats in online classrooms is phishing, where cybercriminals send fraudulent emails pretending to be from a legitimate source, tricking students and staff into sharing login credentials or personal information. Once attackers gain access, they can steal sensitive data, manipulate grades, or spread malware. Similarly, ransomware attacks have become a growing concern for universities and schools, where hackers encrypt critical educational data and demand payment for its release. Institutions without proper backup systems and cybersecurity protocols are often forced to either pay the ransom or risk losing essential academic records (Bandara, Ioras, & Maher, 2014).

Several real-world cases illustrate the increasing cyber threats to e-learning systems. For example, in recent years, multiple universities worldwide have experienced ransomware attacks that disrupted their online learning management systems, blocking students from accessing courses and assignments. In some cases, hackers threatened to leak sensitive student data unless a ransom was paid. These incidents highlight the urgent need for strong cybersecurity strategies, regular vulnerability assessments, and employee training to defend against cybercriminal activities. Without proactive security measures, educational institutions will

remain a primary target for cyberattacks that threaten data integrity, privacy, and academic operations (Ifenthaler & Schumacher, 2016).

Ethical and Legal Challenges in Online Learning Security

As online education expands, the lack of clear cybersecurity regulations has become a growing concern. Many educational institutions rely on third-party learning management systems (LMS) and cloud-based platforms that collect and store vast amounts of student data. However, there are no universal legal frameworks that define how this data should be secured, leading to inconsistencies in privacy protection and cybersecurity enforcement. Some countries have adopted strict data protection laws, such as the General Data Protection Regulation (GDPR) in Europe, but many regions still lack specific regulations addressing cybersecurity risks in education. This legal gap increases the likelihood of data breaches, unauthorized data collection, and misuse of student information (Decuypere, Grimaldi, & Landri, 2021).

Beyond legal concerns, online education platforms raise ethical questions about student privacy and surveillance. Many institutions use monitoring software, AI-driven proctoring tools, and tracking mechanisms to prevent cheating and unauthorized access. While these tools enhance security, they also infringe on student privacy, as they often collect data such as keystrokes, eye movement, and browsing history. The ethical dilemma lies in balancing security with students' right to privacy, as excessive monitoring may create a hostile learning environment and discourage academic freedom (Drachsler & Greller, 2016).

Another controversial issue is the use of learning analytics, which involves analyzing student behavior, progress, and engagement patterns to improve learning outcomes. While learning analytics can help personalize education, it also raises concerns about informed consent and data ownership. Students are often unaware of how their data is collected, stored, and used, leading to debates over whether they should have more control over their personal information. Without transparent policies and ethical guidelines, institutions risk violating student autonomy and trust in digital learning environments (Jones, 2019). Addressing these challenges requires comprehensive cybersecurity policies, ethical data governance, and student-centered privacy protections to ensure that online learning remains both secure and ethically responsible.

3. SOLUTIONS FOR STRENGTHENING CYBERSECURITY IN ONLINE EDUCATION

Implementing Strong Authentication and Encryption

To enhance cybersecurity in online education, strong authentication and encryption mechanisms must be implemented to protect sensitive data from unauthorized access. One of the most effective security measures is multi-factor authentication (MFA), which requires users to verify their identity through multiple steps, such as passwords, biometrics, or security codes. By enforcing MFA for students, teachers, and administrators, educational institutions can significantly reduce the risk of credential theft and unauthorized account access. Many cyberattacks, including phishing and brute-force attacks, exploit weak passwords, making MFA an essential security layer (Alwi & Fan, 2010).

Another crucial security practice is end-to-end encryption, which ensures that data transmitted between students, teachers, and learning platforms remains private and protected. Without encryption, sensitive information—such as login credentials, academic records, and communication logs—can be intercepted by cybercriminals. Encrypting both stored data and real-time communication prevents unauthorized entities from accessing confidential information. Cloud-based e-learning systems, which handle vast amounts of student data, should adopt advanced encryption protocols to safeguard information from breaches (Pardo & Siemens, 2014).

Artificial intelligence (AI) and machine learning (ML) technologies are also becoming powerful tools in cybersecurity threat detection. AI-powered security systems can analyze user behavior, detect anomalies, and identify potential threats before they cause harm. For instance, AI-driven intrusion detection systems (IDS) monitor e-learning platforms in real time, identifying suspicious login attempts, unusual access patterns, or phishing attempts. Additionally, automated security protocols powered by machine learning can respond to threats instantly, preventing data breaches and cyberattacks before they escalate. By integrating MFA, encryption, and AI-based security solutions, educational institutions can create a robust cybersecurity infrastructure that protects online learners and educators from digital threats (Cabaj et al., 2018).

Cybersecurity Awareness and Digital Literacy

Beyond technological defenses, cybersecurity awareness and digital literacy play a crucial role in protecting online education platforms from cyber threats. Many security breaches occur due to human error, such as students and teachers falling victim to phishing emails, weak passwords, or unsafe browsing habits. Therefore, institutions must prioritize cyber hygiene training to ensure that all users understand best practices for securing their digital identities and devices (Rahman et al., 2020).

One of the most common cyber threats in online education is phishing, where attackers trick users into providing login credentials or personal information through fake emails or websites. Many students and teachers fail to recognize these scams, leading to unauthorized access to educational systems. Raising awareness through regular cybersecurity training, email security workshops, and real-time phishing simulations can help users identify suspicious messages and avoid security breaches. Additionally, promoting the use of strong, unique passwords and password managers reduces the risk of account compromise (Bandara, Ioras, & Maher, 2014).

To build long-term cybersecurity resilience, cybersecurity education should be integrated into digital learning curricula. Just as students learn about academic integrity and responsible internet use, they should also be educated on cyber risks, digital ethics, and online safety protocols. Institutions can incorporate interactive cybersecurity modules, gamified learning experiences, and AI-driven security awareness programs to teach students how to recognize cyber threats, secure their accounts, and navigate online education safely. By fostering a culture of cybersecurity awareness, educational institutions can empower students and teachers to actively contribute to a secure online learning environment (Jin et al., 2018).

Regulatory and Institutional Policies for Cybersecurity

A strong regulatory and institutional framework is essential to ensuring cybersecurity in online education. Many educational institutions lack standardized cybersecurity policies, making them vulnerable to data breaches, cyberattacks, and unauthorized access. Implementing comprehensive cybersecurity policies within schools and universities is critical for protecting student data, securing learning platforms, and maintaining academic integrity. Institutions should establish clear guidelines on data access, encryption, and security training while regularly conducting cyber risk assessments to identify potential vulnerabilities (Cabaj et al., 2018).

Governments and international organizations play a key role in defining cybersecurity regulations and global security standards for e-learning. Frameworks such as the General Data Protection Regulation (GDPR) in Europe and the Family Educational Rights and Privacy Act (FERPA) in the United States set strict guidelines on how educational institutions must handle student data. However, many countries lack specific cybersecurity policies for online learning, leaving educational institutions to develop their own security measures. Establishing global cybersecurity standards for e-learning can help ensure that all students, regardless of their location, receive safe and secure access to online education (Pardo & Siemens, 2014).

Collaboration between technology providers, policymakers, and educators is crucial for improving cybersecurity in digital education. Tech companies that develop learning management systems (LMS), cloud storage services, and AI-driven educational tools must work alongside governments and academic institutions to ensure that cybersecurity standards are met. This collaboration can lead to the development of secure educational technologies, improved compliance with data protection laws, and stronger enforcement of cybersecurity best practices. By aligning institutional policies with global cybersecurity regulations, the education sector can effectively protect students and educators from digital threats while maintaining trust and integrity in online learning (Drachsler & Greller, 2016).

4. THE FUTURE OF CYBERSECURITY IN ONLINE EDUCATION

The Role of Artificial Intelligence and Blockchain in Data Security

As online education continues to expand, Artificial Intelligence (AI) and Blockchain are expected to play a transformative role in enhancing cybersecurity. AI-powered security systems can significantly improve threat detection, incident response, and risk assessment by analyzing vast amounts of data in real-time. Machine learning algorithms can detect unusual access patterns, phishing attempts, and suspicious activities, automatically triggering security measures before a breach occurs. These AI-driven cybersecurity tools can help educational institutions prevent cyberattacks proactively, reducing the reliance on traditional, reactive security methods (Cabaj et al., 2018).

In addition to AI, blockchain technology offers promising solutions for securing academic records and credential verification. Currently, many educational institutions store student data in centralized databases, making them vulnerable to hacking and data manipulation. Blockchain, however, operates on a decentralized ledger, ensuring that student credentials, certificates, and academic transcripts cannot be altered or forged. With blockchain, universities can issue and verify digital diplomas securely, reducing the risk of academic fraud. Furthermore, blockchain-based authentication systems can improve identity management in e-learning platforms, ensuring that only authorized users access educational resources (Alam, 2022).

By integrating AI-driven security automation and blockchain-based authentication, the future of cybersecurity in online education will become more robust, transparent, and resistant to cyber threats. These technologies will not only enhance data protection but also help build trust and accountability in digital learning environments. However, successful implementation requires collaboration between educational institutions, technology providers, and policymakers to develop scalable and standardized security frameworks that ensure safety and privacy in the evolving e-learning ecosystem (Drachsler & Greller, 2016).

Enhancing Ethical Cybersecurity Practices in E-Learning

As cybersecurity measures in online education become more sophisticated, ethical considerations surrounding data security and student privacy must also evolve. While institutions implement advanced tracking, AI-driven surveillance, and data analytics, there is a growing debate on how to balance security with individual privacy rights. Overly aggressive monitoring, such as proctoring software that tracks eye movements, keystrokes, and browser activity, has raised concerns about student autonomy and digital rights. Striking the right balance requires transparent policies, clear communication with students, and the development of privacy-respecting cybersecurity frameworks (Ifenthaler & Schumacher, 2016).

One key area for ethical improvement is the future of student consent mechanisms in data analytics. Many e-learning platforms collect detailed behavioral data to personalize learning experiences and track student progress. However, students often have little control or knowledge over how their data is used. Moving

forward, institutions should adopt informed consent models, where students are given clear choices about what data is collected and how it is processed. Additionally, integrating privacy-by-design principles—where cybersecurity frameworks are built to prioritize privacy from the outset—can help ensure that security measures do not infringe on student rights (Jones, 2019).

In the future, ethical cybersecurity practices in e-learning will require a collaborative approach involving educational institutions, technology providers, and policymakers. By prioritizing both data security and student privacy, institutions can create a safer and more transparent learning environment that fosters trust, academic freedom, and responsible data usage. As technology continues to shape online education, ethical decision-making and regulatory oversight will be essential to ensuring that cybersecurity measures remain student-centered and privacy-conscious (Pardo & Siemens, 2014).

Evolving Cybersecurity Frameworks for Global E-Learning

As e-learning continues to expand across borders, cybersecurity frameworks must evolve to address the growing threats in digital education. International organizations such as the United Nations Educational, Scientific and Cultural Organization (UNESCO), the European Union Agency for Cybersecurity (ENISA), and the International Telecommunication Union (ITU) play a critical role in establishing global cybersecurity standards for online education. These organizations work to create guidelines, best practices, and regulatory frameworks that help governments and educational institutions implement secure e-learning environments. However, the lack of universal cybersecurity policies remains a significant challenge, as different countries enforce varying levels of data protection and cybersecurity regulations (Komljenovic, 2021).

Looking ahead, the advancement of cybersecurity policies and technologies will be crucial in ensuring the safety and integrity of online education systems worldwide. Future developments may include stronger global data protection regulations, standardized cybersecurity certifications for educational institutions, and AI-powered security monitoring systems that can detect and respond to threats in real time. Additionally, automated compliance tools could help institutions adhere to international cybersecurity standards, reducing the complexity of managing cross-border digital education programs. The integration of blockchain for secure credential verification, zero-trust security models, and quantum encryption technologies are also expected to shape the future of cybersecurity in e-learning (Drachsler & Greller, 2016).

To build a resilient and secure global e-learning ecosystem, collaboration between governments, educational institutions, tech companies, and international regulators will be essential. By fostering knowledge sharing, policy harmonization, and technological innovation, the global education sector can ensure that students and educators have access to safe, privacy-conscious, and cyber-resilient online learning environments. As the digital transformation of education continues, the need for proactive, scalable, and adaptive cybersecurity frameworks will only become more urgent (Jones, 2019).

CONCLUSION

With the proliferation of online schooling, the necessity for comprehensive cybersecurity measures is becoming increasingly vital. The incorporation of digital learning platforms has enhanced accessibility, flexibility, and innovation in education; yet, it has also subjected students, educators, and institutions to significant cyber dangers, such as data breaches, identity theft, and privacy infringements. In the absence of robust security protocols, online education may become an attractive target for hackers, endangering student privacy and the integrity of educational institutions. To align with the digital transformation of education, cybersecurity frameworks must perpetually adapt, integrating emerging technology and more robust regulatory laws (Cabaj et al., 2018).

Although technological innovations like AI-driven security monitoring, blockchain-based credential verification, and multi-factor authentication offer critical safeguards, technology by itself is insufficient. A comprehensive cybersecurity strategy is essential, including technology solutions, institutional policies, international rules, and cybersecurity education. Governments and educational institutions must cooperate to create global cybersecurity standards, implement stringent data protection regulations, and include cybersecurity awareness training into digital learning settings. Equipping students and educators with the expertise to identify and avert cyber dangers is equally crucial as establishing safe learning platforms (Drachsler & Greller, 2016).

Ultimately, cybersecurity in online education constitutes a collective obligation. As digital learning increasingly influences the future of education, institutions must emphasize security, privacy, and ethical issues to establish a safe, reliable, and robust online learning environment. By implementing comprehensive security methods, the education sector may fully leverage online learning while effectively reducing cyber risks, ensuring that digital education remains innovative and secure (Jones, 2019).

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Adaptive Learning with AI: How Bots Personalize Foreign Language Education

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Abstract: The integration of artificial intelligence (AI) in language education has led to the emergence of adaptive learning systems that personalize instruction based on individual learners' needs. AI-powered chatbots and virtual tutors offer real-time feedback, interactive engagement, and accessibility, making foreign language learning more efficient. This paper explores the advantages and challenges of AI-driven adaptive learning in language acquisition. While AI enhances personalized learning paths, engagement through gamification, and 24/7 accessibility, it also presents limitations such as a lack of human interaction, authenticity issues, and challenges in assessing fluency and creativity. Additionally, ethical concerns arise regarding its integration into formal curricula and its potential over-reliance by learners. The article argues that AI should be viewed as a complementary tool rather than a replacement for human instruction. Future advancements in AI models, incorporating cultural awareness and emotional intelligence, may bridge some of these gaps, making AI-driven language learning even more effective. A balanced approach, where AI supplements rather than replaces traditional teaching, is essential to ensuring comprehensive and meaningful language acquisition.

***Keywords**: Adaptive learning, AI in language education, Chatbots for language learning, Personalized learning, Foreign language acquisition.*

1. INTRODUCTION

Integrating artificial intelligence (AI) in education has transformed traditional learning methods, making them more personalized and interactive. AI-driven tools like chatbots and virtual tutors have become increasingly prevalent in various educational fields, particularly in foreign language acquisition. These technologies leverage machine learning algorithms to adapt to individual learners, offering real-time feedback and customized learning experiences.

Adaptive learning refers to an instructional approach where AI tailors educational content and activities to meet the unique needs of each learner. In foreign language education, AI-powered chatbots simulate conversations, provide instant corrections, and adjust difficulty levels based on a learner's proficiency. This level of personalization helps learners progress at their own pace, reinforcing areas where they struggle while advancing through mastered concepts efficiently (Kabudi, Pappas, & Olsen, 2021).

Despite these advantages, AI-powered adaptive learning systems present certain challenges. While they enhance personalized feedback, engagement, and accessibility, concerns remain regarding their lack of human interaction, contextual accuracy, and cognitive engagement. This article explores both the benefits and limitations of AI chatbots in foreign language learning, arguing that while they are powerful tools, they should complement rather than replace traditional teaching methods.

2. THE ADVANTAGES OF AI-POWERED ADAPTIVE LEARNING IN LANGUAGE EDUCATION

Personalized Learning Paths

One of the most significant advantages of AI-powered adaptive learning is its ability to tailor learning experiences to individual students. Unlike traditional methods, where learners follow a fixed curriculum regardless of their abilities, AI-driven platforms analyze students' proficiency levels and adjust the material accordingly. This ensures that each learner progresses at an optimal pace, receiving content that matches their strengths and areas of improvement.

AI chatbots and virtual tutors provide instant feedback based on learners' responses, allowing them to correct mistakes in real time. Through natural language processing (NLP), these systems can identify common grammatical errors, vocabulary misuse, and pronunciation issues, offering targeted corrections. This personalized approach eliminates repetitive learning of already mastered topics, allowing students to focus on areas where they need the most improvement (Gligorea et al., 2023). By continuously adapting to users' needs, AI-driven language education becomes more efficient and effective, fostering long-term retention and skill development.

Engagement and Interactivity

AI-powered chatbots play a crucial role in enhancing engagement by simulating real-life conversations, making language learning more interactive and immersive. Unlike traditional learning methods that rely heavily on textbooks and structured exercises, AI chatbots allow learners to practice communication in real-time without the pressure of speaking with a human. These bots can mimic natural conversations, ask follow-up questions, and even adjust their responses based on the learner's fluency and accuracy. This dynamic interaction helps students build confidence in speaking and improves their conversational skills in a way that static exercises cannot achieve (Wei, 2023).

Additionally, gamification elements have further revolutionized AI-powered language learning. Many adaptive learning platforms incorporate rewards, leaderboards, and progress tracking to keep learners motivated. Features such as streak challenges, achievement badges, and interactive storytelling make the learning process feel more like a game than a traditional classroom experience. This engagement-driven approach increases learners' commitment, making them more likely to practice consistently, which is key to mastering a foreign language.

Efficiency and Accessibility

One of the most compelling advantages of AI-powered adaptive learning is its efficiency and accessibility. Unlike human instructors who have time constraints, AI-driven chatbots and virtual tutors are available 24/7, providing learners with immediate support whenever they need it. This continuous availability ensures that students can practice at their own pace, reinforcing their skills without waiting for scheduled lessons. Additionally, AI systems can handle multiple learners simultaneously, making personalized tutoring more scalable and cost-effective.

Beyond efficiency, AI also removes barriers for learners who have limited access to traditional language education. Many students around the world face challenges such as geographic limitations, financial constraints, or a lack of qualified language instructors. AI-powered learning platforms make foreign language education more inclusive by offering low-cost, internet-based solutions that do not require physical classrooms or expensive tutoring. These tools democratize learning, making it possible for individuals from diverse backgrounds to gain language proficiency regardless of their location or socioeconomic status (Baidoo-Anu & Ansah, 2023). By bridging the accessibility gap, AI is reshaping language learning into a more inclusive and globally available experience.

3. THE CHALLENGES AND LIMITATIONS OF AI IN LANGUAGE LEARNING

Lack of Human Interaction

While AI-powered adaptive learning provides efficiency and personalization, one of its major limitations is the lack of human interaction, which is crucial in foreign language acquisition. Learning a language is not just about memorizing vocabulary and grammar rules; it also involves understanding cultural and emotional nuances that shape communication. These subtle aspects of language, such as tone, humor, idiomatic expressions, and non-verbal cues, are difficult for AI chatbots to teach effectively. Without exposure to these elements, learners may struggle to use the language naturally in real-life conversations.

Additionally, AI systems cannot replicate the depth of human-to-human communication. In traditional language learning, teachers and native speakers can interpret learners' emotions, motivation levels, and non-verbal cues, adjusting their teaching strategies accordingly. AI lacks this capability, making it less effective in fostering meaningful and contextually rich interactions. While AI chatbots can provide structured conversation practice, they cannot fully replace human instructors, who bring empathy, cultural awareness, and real-world experience into the learning process (Pokrivcakova, 2019). As a result, AI should be viewed as a complementary tool rather than a substitute for human-led language education.

Authenticity and Accuracy Issues

One of the key concerns in AI-driven language learning is the authenticity and accuracy of the language generated by chatbots and virtual tutors. While AI models are trained on vast datasets, they sometimes produce linguistically correct but contextually inappropriate responses. Language is deeply influenced by cultural, social, and situational factors, and AI often struggles to fully grasp these subtleties. This limitation can lead to unnatural phrasing, misinterpretation of idioms, or inappropriate word choices, which may misguide learners and negatively impact their fluency.

Another major issue is the risk of over-reliance on AI tools, which can reduce critical thinking and creativity in language use. If learners depend too much on AI-generated corrections and translations, they may fail to develop independent problem-solving skills, such as rephrasing or inferring meaning from context. Additionally, excessive reliance on AI can hinder the natural trial-and-error process, which is essential for mastering a language. While AI can be a valuable assistant, effective language acquisition requires learners to actively engage with real-world materials, human interactions, and creative language exercises (Kasneci et al., 2023). To maximize the benefits of AI in language education, it is crucial to integrate it as a supportive tool rather than a replacement for active learning and critical engagement.

Ethical and Pedagogical Concerns

The integration of AI-powered adaptive learning into language education raises ethical and pedagogical concerns, particularly regarding its role in formal curricula and assessment methods. While AI provides valuable support in personalized learning, there is a growing concern that it may be misused as a replacement for human educators rather than a supplementary tool. The lack of proper integration into language curricula can lead to over-dependence on AI-driven solutions, potentially devaluing the role of human teachers. Educators play a critical role in fostering interactive discussions, cultural awareness, and emotional intelligence, which AI cannot replicate. To ensure ethical implementation, institutions must strike a balance between AI assistance and teacher-guided learning, allowing technology to enhance rather than replace traditional methods.

Another major limitation of AI in language learning is its inability to assess subjective elements such as fluency, creativity, and emotional expression. Unlike human instructors who can evaluate tone, originality,

and contextual appropriateness, AI primarily focuses on grammatical correctness and structural coherence. This limitation makes it less effective in assessing open-ended writing, spontaneous speech, and creative language use, which are crucial for full proficiency. Without human evaluation and feedback, learners may struggle with more nuanced aspects of language acquisition, limiting their ability to communicate naturally and persuasively (Lin, Huang, & Yang, 2023). Therefore, while AI can enhance efficiency and accessibility, it must be carefully integrated into curricula with human oversight to ensure a well-rounded language education.

4. FUTURE PROSPECTS: THE ROLE OF AI IN LANGUAGE LEARNING DEVELOPMENT

The Potential Improvements in AI-Driven Language Education

As AI technology continues to evolve, its potential to enhance language learning is expanding rapidly. Future developments in machine learning and natural language processing (NLP) will enable AI-driven tutors to provide more accurate, context-aware, and personalized language support. Advanced speech recognition technologies will improve pronunciation training, allowing learners to receive detailed phonetic feedback. Additionally, AI-powered systems will likely incorporate more adaptive learning pathways, identifying specific weaknesses and dynamically adjusting lesson plans in real time. These advancements will reduce common AI limitations, such as grammatical rigidity and unnatural phrasing, ultimately leading to a more effective and intuitive learning experience (Kung et al., 2023).

How AI and Human Instructors Can Complement Each Other

Rather than replacing traditional teaching, AI should be integrated as a complementary tool alongside human instructors. AI excels at providing instant feedback, adaptive exercises, and repetitive practice, while human educators bring emotional intelligence, cultural insights, and in-depth language expertise to the classroom. In a blended learning model, AI can handle routine grammar corrections and vocabulary drills, allowing teachers to focus on interactive discussions, creative expression, and real-world language application. This partnership can make language education more efficient and engaging, ensuring that learners benefit from both structured AI-driven practice and meaningful human interaction (Pokrivcakova, 2019).

The Future of Adaptive AI Models Integrating Cultural and Emotional Intelligence

A major challenge in AI-driven language learning has been its lack of cultural and emotional awareness, but future models may overcome this limitation through advanced deep learning and sentiment analysis. By incorporating emotion recognition and cultural adaptation, AI chatbots could adjust responses based on the learner's tone, intent, and emotional state, making conversations feel more natural and human-like. Additionally, AI systems may be trained on regional dialects, idiomatic expressions, and cultural nuances, allowing learners to gain a more authentic understanding of language. These innovations will bring AI-driven adaptive learning closer to human-like interaction, making language education more immersive and effective (Fanni et al., 2023).

CONCLUSION

AI-powered adaptive learning has significantly transformed foreign language education by offering personalized learning experiences, increased engagement, and greater accessibility. Through real-time feedback, AI-driven chatbots and virtual tutors provide learners with tailored support, allowing them to progress at their own pace. However, despite these advantages, AI cannot fully replace the human element that is essential for cultural understanding, emotional intelligence, and nuanced communication. The most effective approach to language learning lies in a balanced integration of AI and traditional instruction, where

AI serves as a supportive tool rather than a substitute for human educators. By leveraging AI's strengths while ensuring teacher-led guidance and real-world interaction, language education can become more efficient, engaging, and comprehensive, ultimately preparing learners for authentic and meaningful communication in their target language.

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Harnessing Hydrogen: The Next Step in Renewable Energy Evolution

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Abstract: The problem of anthropogenic climate change and its inextricable link to the current and future energy needs of our global society is the greatest challenge facing our planet. Hydrogen is increasingly acknowledged as a crucial element of a potential energy framework for the 21st century, providing a feasible solution for reducing environmental emissions, improving sustainability, and bolstering energy security. Hydrogen offers a low-impact alternative with potential uses in transportation, decentralized heat and power generation, and energy storage systems, which might substantially mitigate environmental damage on both local and global levels. Nonetheless, the shift from a fossil fuel-dependent energy framework to a hydrogen-based economy presents significant scientific, technological, and socio-economic obstacles. This paper seeks to clarify the forces propelling the worldwide interest in hydrogen energy and critically analyzes essential concerns influencing its future as a primary energy vector.

***Keywords**: Adaptive learning, AI in language education, Chatbots for language learning, Personalized learning, Foreign language acquisition.*

INTRODUCTION

Hydrogen is possibly the most elementary element that exists. A hydrogen atom has a single proton and a single electron. It is the most prevalent element in the universe. Notwithstanding its simplicity and prevalence, hydrogen does not exist naturally on Earth in its gaseous form; it invariably bonds with other elements. Water is a chemical composed of hydrogen and oxygen (H2O). Hydrogen is among the most prevalent elements in the Earth's crust. Hydrogen in gaseous form does not occur naturally on Earth and must be synthesized. Data training concluded in October 2023. This occurs because hydrogen gas is less dense than air, causing it to ascend into the atmosphere. Natural hydrogen is invariably found in conjunction with other elements in intricate compounds, including water, coal, and oil.

PROPERTIES AND CHARACTERISTICS OF HYDROGEN

Hydrogen possesses the highest energy density among all conventional fuels. Conversely, hydrogen possesses the lowest energy density by volume. It is the least dense element and exists as a gas under standard temperature and pressure conditions. Hydrogen is present in numerous chemical molecules and in water. It is the most prevalent element on Earth. However, it does not exist naturally in its gaseous form. It consistently interacts with other elements, like as oxygen, to create water. Upon separation from another element, hydrogen can be combusted as fuel or transformed into power. Hydrogen is absent as a gaseous component in the Earth's atmosphere, necessitating its extraction from other substances. The two predominant processes for hydrogen production are electrolysis, often known as water splitting, and steam reforming. Steam reforming is presently the most economical technique for hydrogen production. It is utilized in industry to segregate hydrogen atoms from carbon atoms in methane. As methane is a fossil fuel, the steam reforming process generates greenhouse gas emissions associated with global warming. A different technique for generating hydrogen is electrolysis. Electrolysis entails the passage of an electric current through water to dissociate it into its fundamental constituents, hydrogen and oxygen. Hydrogen is subsequently gathered at the negatively charged cathode, while oxygen is collected at the positively charged

anode. The hydrogen formed through electrolysis is highly pure and emits no pollutants, as electricity may be sourced from renewable energy. Regrettably, electrolysis is presently a highly costly procedure. Hydrogen is present in numerous organic molecules, particularly in hydrocarbons that constitute fuels like gasoline, natural gas, methanol, and propane.

Hydrogen can be extracted from hydrocarbons with the use of heat, a process referred to as reforming. The majority of hydrogen is presently generated from natural gas using this method. Electric current can be utilized to dissociate water into its constituent oxygen and hydrogen elements. This procedure is referred to as electrolysis. Certain algae and bacteria utilize sunlight as an energy source and can release hydrogen under specific conditions. 2 Several experimental techniques for hydrogen production exist, including photo-electrolysis and biomass gasification. Researchers have discovered that certain algae and bacteria utilize sunlight as an energy source to generate hydrogen under specific conditions.

Hydrogen can be sourced from various origins, including renewable (hydropower, wind, wave, sun, biomass, and geothermal) and non-renewable (coal, natural gas, and nuclear) resources. It can be stored as fuel and utilized in transportation and distributed heat and power systems via fuel cells, internal combustion engines, or turbines, with water as the sole by-product at the site of use.

HYDROGEN AS AN ENERGY SOURCE

Hydrogen's potential to substitute fossil fuels in the transportation sector may address a significant global environmental issue (Jacobson et al. 2005). Vehicle emissions are presently among the foremost contributors to air pollution globally, particularly in metropolitan environments, and they also play a substantial role in the world's carbon dioxide emissions. Hydrogen can serve as a storage medium for electricity produced from continuous renewable sources, including solar, wind, wave, and tidal power, so addressing a primary challenge of sustainable energy: the issue of consistent supply. Hydrogen is considered a genuinely "green" fuel when derived from non-fossil fuel feedstocks. Moreover, domestic hydrogen production facilitates the utilization of renewable energy within the transportation sector, possibly yielding significant economic and energy security benefits, together with the advantages of new infrastructure grounded in distributed generation. The pivotal aspect of hydrogen's energy storage capability establishes a robust connection between sustainable energy technologies and a sustainable energy economy, sometimes referred to as the "hydrogen economy" (Muradov and Veziroglu 2005). The significance of hydrogen as a prospective energy carrier has markedly risen during the past decade, attributed to swift advancements in fuel cell technology. Hydrogen-powered fuel cells possess the potential to serve as important catalysts for the transition to a sustainable energy system characterized by low carbon emissions.

FUTURE PROSPECTS OF HYDROGEN ENERGY

Numerous nations are already formulating strategies for the advancement of fuel cells and hydrogen technologies, frequently accompanied with explicit numerical objectives. The primary emphasis of hydrogen research and development has been on the transportation sector, where the majority of the world's leading automakers have made substantial investments in fuel cell vehicle research initiatives. Figure 1 depicts the pivotal function of hydrogen as an energy carrier, integrating diverse hydrogen production techniques and a range of end-user applications. A primary appeal of hydrogen as an energy carrier is the diverse array of manufacturing methods derived from various sources.

Hydrogen can be generated from coal, natural gas, and other hydrocarbons through multiple methods, including electrolysis of water, photolytic decomposition, high-temperature thermochemical cycles, biomass, and municipal garbage. The variety of production sources substantially enhances energy supply security. A conventional energy chain for hydrogen encompasses the production, distribution, transportation, storage, and eventual utilization of hydrogen. 3 The energy chain for sustainable hydrogen

energy encompasses the capture of solar or alternative energy sources to produce hydrogen as an energy carrier, its storage for utilization in fuel cells or combustion-based devices, and its delivery. The eventual establishment of a hydrogen-based economy may yield significant environmental and economic advantages, as well as improved energy supply security. The most persuasive rationale for a sustainable hydrogen economy is its capacity to significantly diminish global carbon emissions.

CHALLENGES AND BARRIERS TO A HYDROGEN ECONOMY

The shift from a carbon-based (fossil fuel) energy system to a hydrogen-based economy presents considerable scientific, technological, and social obstacles to establishing hydrogen as the future clean energy source. In 2004, the United States National Research Council and the National Academy of Engineering, in their report "The Hydrogen Economy: Opportunities, Costs, Barriers, and R&D Needs," identified four principal obstacles to realizing the concept of a hydrogen economy. Design and implement efficient, sustainable, secure, and ecologically preferable fuel cell systems and hydrogen storage solutions. Establish the infrastructure to supply hydrogen to light-duty vehicle operators. Significantly decrease the expenses associated with hydrogen production from renewable energy sources. Capture and sequester CO2, a byproduct of hydrogen synthesis derived from coal and natural gas. Decentralized generation of heat and power via local or broader hydrogen supply networks. The subsequent sections outline several problems encountered in the transition to a hydrogen economy.

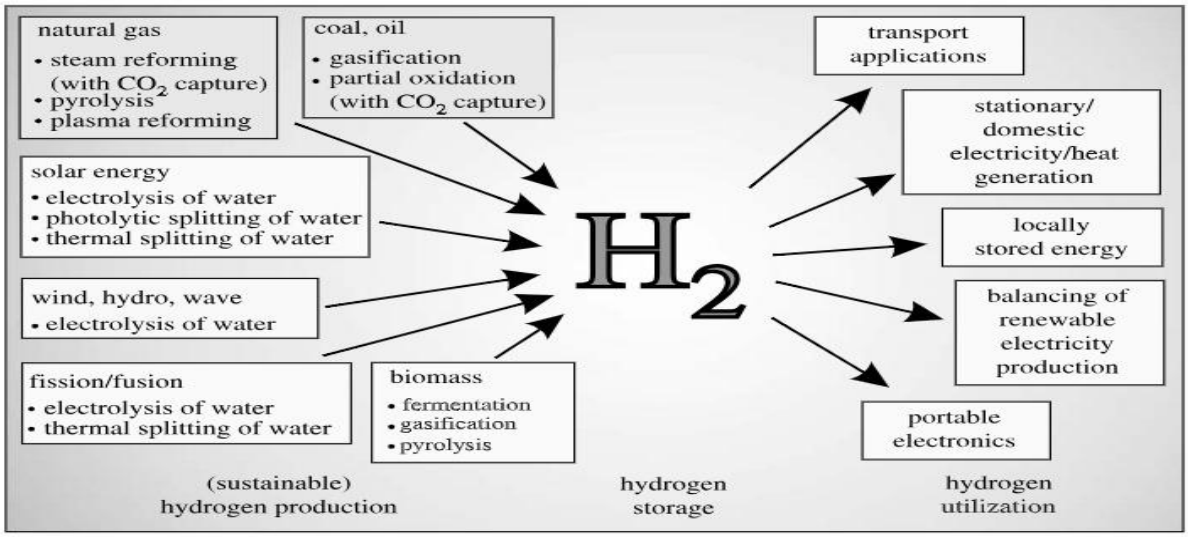

Figure 1. Hydrogen as an energy carrier links multiple hydrogen production methods to various end users through storage. Shadow production routes can involve significant carbon dioxide (by-product) production.

Hydrogen generation and dissemination. Hydrogen ranks as the third most prevalent chemical element in the Earth's crust, however it is perpetually combined with other elements in chemical compounds. Consequently, it must be synthesized from alternative hydrogen-containing sources utilizing energy, such as electricity or thermal energy. Hydrogen is presently generated in substantial volumes from fossil fuels using the steam reforming of natural gas and the partial oxidation of coal or heavy hydrocarbons (see to Sigfusson 2007). These methods can leverage economies of scale and are presently the most cost-effective and well-established ways for large-scale hydrogen production. They can be utilized in the short to medium term to satisfy the demand for hydrogen fuel and to facilitate the testing and validation of technology related to hydrogen production, storage, distribution, safety, and utilization. In the long term, it is evidently unsustainable for the hydrogen economy to rely on hydrogen sourced from hydrocarbons. The generation of hydrogen from fossil fuels via reforming and gasification processes invariably results in the emission of

carbon dioxide as a by-product. Carbon dioxide emissions, a primary contributor to global climate change, are produced in large-scale facilities via a process known as carbon capture, which entails the underground capture, liquefaction, transportation, and storage of carbon dioxide, such as in depleted natural gas and oil wells or geological formations. Nonetheless, all sequestration procedures are energy-intensive, expensive, and possibly harmful to the environment. The primary risk arises from the unpredictable long-term environmental effects of carbon dioxide sequestration. A more advantageous method for hydrogen production devoid of carbon dioxide emissions is the high-temperature pyrolysis of hydrocarbons, biomass, and municipal solid waste, resulting in hydrogen and solid carbon black, which may be readily utilized or sequestered industrially. The expense of this technique is presently considerably more than that of steam reforming of natural gas. To realize the advantages of a genuinely sustainable hydrogen energy system, it is imperative to transition to hydrogen production from non-fossil resources, such as water (Turner 2004; P. P. Edwards et al. 1046 Phil. Trans. R. Soc. A (2007) Sheriff et al. 2005; Penner 2006). Hydrogen can be generated by dissociating water via several methods, including electrolysis, photoelectrolysis, high-temperature decomposition, and photobiological water splitting. The commercial production of hydrogen using water electrolysis attains an efficiency of 75%; yet, the cost of hydrogen is presently many times greater than that of fossil fuels (Dutton 2002; Ewan & Allen 2005; International Energy Agency 2006). Electricity generated by renewable energy sources (such as wind, wave, and tidal) can satisfy local hydrogen requirements; nevertheless, it will undoubtedly fall short of fulfilling the global demand for hydrogen as a prevalent energy source. The generation of hydrogen through biological reformation and fermentation of biomass utilizing microorganisms is evidently appealing, provided it can be shown that this method can yield the substantial quantities of hydrogen needed. This process emits carbon dioxide, which can be mitigated by enhancing biomass, rendering it carbon dioxide neutral. Nevertheless, prudence is important; the utilization of fertilizers for cultivating plants or biomass inevitably incurs a "CO2 cost," as ammonia is required for fertilizer synthesis, and this ammonia is produced from hydrogen and nitrogen, with the former being derived from hydrocarbons. 4 The ultimate objective of hydrogen generation is the effective, direct conversion of sunlight using a photocatalytic process to dissociate water into its constituent elements, hydrogen and oxygen, without employing energy. This optimal manufacturing method harnesses solar energy to extract water from the oceans, resulting in "solar hydrogen." A new analysis from the US Department of Energy (DoE) indicates that solar water splitting is the sole significant, long-term, CO2-free method for the mass generation of the substantial quantities of H2 required for the establishment of a hydrogen economy. U.S. Department of Energy, Office of Science (2003). Attaining cost-effective and efficient solar hydrogen production necessitates the advancement of creative materials, novel physical phenomena, new synthetic methodologies, and wholly original design concepts. Current nuclear (fission) technology generates electricity that can facilitate hydrogen production through the electrolysis of water. Advanced nuclear reactors are being designed to facilitate high-temperature water electrolysis (independent of power) or thermochemical cycles that utilize heat and chemical processes to dissociate water. If successfully developed, fusion power might serve as a substantial source of clean, abundant, and carbon-free hydrogen generation. The existing transportation infrastructure for distributing conventional fuels to customers is not readily adaptable for hydrogen use. Hydrogen transportation methods encompass compressed gas (200 bar) in steel tube cylinders, liquid hydrogen tanks, and localized hydrogen pipeline networks, among others. All of these alternatives are costly and substantially increase the expense of hydrogen for consumers. Innovative strategies will be essential to minimize delivery expenses while upholding stringent safety standards, from manufacturing to end-user refilling. Consequently, the primary elements of the hydrogen delivery infrastructure must to be established immediately to facilitate local hydrogen recharging stations for transportation—commonly regarded as the inaugural significant foray into the hydrogen economy. Subsequently, the elements of a national hydrogen delivery and distribution network that guarantees a dependable supply of economical hydrogen must be established. Establishing a new hydrogen network necessitates substantial investment, along with research and development of innovative

materials, cost-effective compressor technology, seals, sensors, and controls, in addition to the filling station infrastructure essential for the safety of any hydrogen transport system. A decentralized framework Hydrogen production for localized energy and hydrogen filling stations will be centralized in small-scale facilities, necessitating entirely new specifications for dimensions, manufacturing costs, and other parameters. In regions without natural gas, hydrogen can be optimally generated on-site from water, methanol, or ammonia, utilizing electricity—preferably sourced from renewable energy, such as wind, solar, or biofuels. Local hydrogen production may align more well with the distribution of available fuels; nevertheless, CO2 sequestration may be less efficient compared to large-scale centralized production. Upon the successful integration of hydrogen into the energy sector, the optimal long-term solution for hydrogen distribution would entail a network of pipelines linking centralized hydrogen production facilities to stationary consumers and mobile refueling stations. Nonetheless, in certain regions, like remote refueling stations or residences utilizing water electrolysis, efficient small-scale reforming facilities, or alternative sophisticated hydrogen production techniques, local hydrogen production may remain more cost-effective.

HYDROGEN STORAGE TECHNOLOGIES

Live hydrogen storage is regarded by many as one of the most significant and technically demanding challenges to the extensive adoption of hydrogen as an effective energy carrier (Crabtree et al. 2004; Harris et al. 2004). Hydrogen possesses a higher energy density by weight than any other material. Regrettably, being the lightest chemical element in the periodic table, it possesses a markedly low energy density per unit volume (Table 1). The hydrogen economy necessitates two categories of hydrogen storage systems: one for transportation and another for stationary purposes. Both possess distinct requirements and constraints. The transportation industry is anticipated to be the initial significant consumer of hydrogen in the forthcoming hydrogen economy. The hydrogen storage criteria for transportation applications are more rigorous than those for stationary uses. The operational specifications for an optimal hydrogen storage system for transportation applications encompass:— multi-state hydrogen uptake/release reversibility (minimum of 500 cycles),— low operating pressure (below 4 bar),— operating temperature range from 50 K to 150 °C,— rapid hydrogen uptake/release kinetics,— elevated gravimetric and volumetric hydrogen density (minimum of 9% by weight and at least 70 g H2 per liter of storage system), — safety parameters and public acceptance during operation, and — hydrogen storage system cost below £15/kg. Storage systems are nonexistent. Figure 2 illustrates a facet of the issue with on-board hydrogen storage, depicting the volume and weight of 4 kg of hydrogen storage across several systems (4 kilogram of hydrogen is adequate to propel a fuel cell car for 500 km). In stationary applications, the limits of weight and volume for hydrogen storage are less critical than in vehicular contexts; stationary hydrogen storage systems can utilize extensive space, function at elevated temperatures and pressures, and provide supplementary power to offset sluggish kinetics. Nonetheless, hydrogen storage for stationary applications presents a significant scientific and technical barrier, particularly concerning storage materials. 5 Presently, hydrogen storage methods rely on high-pressure gas cylinders or cryogenically liquefied hydrogen. Conventional steel cylinders may contain hydrogen at 200 bar and possess a gravimetric density of around 1 wt% (1 wt% of stored hydrogen corresponds to a reserve energy of 186 Wh kg^{-1}). Recently engineered ultra-high-density composite cylinders constructed from premium carbon fiber can contain hydrogen at pressures between 700 and 1000 bar, achieving a gravimetric hydrogen density of up to 10 wt%. Nonetheless, these high-pressure cylinders are costly and necessitate intricate and costly filling apparatus. Storing hydrogen as a cryogenic liquid provides a markedly greater gravimetric density compared to compressed gas, with liquid hydrogen exhibiting a density of 70.8 g L^{-1} at 252.88°C and 1 bar. Nonetheless, this density remains 14 times inferior to that of water. Cryogenic liquid containers necessitate highly effective insulation to maintain hydrogen in its liquid state. Despite optimal insulation, the evaporation rate for small transport tanks is no less than 1% per day. Although compressed and liquid storage options for hydrogen are accessible, these methods fail to satisfy numerous aforementioned requirements, as well as the medium- and long-term

objectives established for transportation hydrogen storage systems (U.S. Department of Energy, Office of Science 2003).

This collection of rigorous and integrated requirements presents a significant scientific obstacle for the advancement of dependable hydrogen storage for transportation; at now, hydrogen storage devices capable of concurrently satisfying all these criteria are nonexistent. Figure 2 illustrates a facet of the on-board hydrogen storage challenge, depicting the volume and mass of 4 kg of hydrogen across several storage technologies (4 kilogram of hydrogen suffices to propel a fuel cell vehicle for 500 kilometers). In stationary applications, the limits of weight and volume for hydrogen storage are less critical than in cars; stationary hydrogen storage systems can utilize extensive space, function at elevated temperatures and pressures, and provide supplementary power to offset sluggish kinetics. Storing hydrogen for stationary applications is a significant scientific and technical problem, particularly regarding storage materials. Presently, hydrogen storage alternatives rely on high-pressure gas cylinders or cryogenically chilled liquid hydrogen. Conventional steel cylinders may contain hydrogen at 200 bar and possess a gravimetric density of around 1 wt% (1 wt% of stored hydrogen corresponds to a reserve energy of 186 Wh kg^{-1}). Recently, ultra-high-performance carbon fiber tubes have been created.

These technologies incur a substantial energy penalty, requiring up to 20% of hydrogen's energy content for gas compression and up to 30% for liquefaction. A significant concern for high-pressure and cryogenic storage facilities is the public perception and acceptance of compressed gas and liquid hydrogen storage. Hydrogen storage necessitates a significant technological advancement, which is anticipated to occur in Azerbaijan. The most feasible alternative to compressed and liquid hydrogen is the storage of hydrogen in solid or liquid forms. The advancement of novel solid-state hydrogen storage materials may signify a transformative shift in hydrogen storage technology and significantly influence the transition to a hydrogen economy (Crabtree et al. 2004; Harris et al. 2004). Figure 3 illustrates the gravimetric and volumetric energy densities of chemically stored hydrogen employing diverse storage techniques. Neither cryogenic nor high-pressure hydrogen storage methods seem capable of fulfilling the Department of Energy's medium-term objectives for transportation applications (U.S. Department of Energy, Office of Science 2003). Solid-state hydrogen storage utilizing ionic-covalent hydrides of light elements, including lithium, boron, sodium, magnesium, and aluminum (or their combinations), is increasingly acknowledged as the sole method capable of attaining the requisite gravimetric and volumetric target densities. A solid-state storage material appropriate for transportation must have a high gravimetric and volumetric hydrogen density while rapidly absorbing and desorbing hydrogen at or near ambient temperature and pressure. Ideally, this material should be synthesized from cost-effective substances using an energy-efficient preparation technique, exhibit resistance to contamination from trace impurities, possess excellent thermal conductivity in both loaded and unloaded states, ensure safety and reusability in atmospheric contact, be recyclable, and facilitate straightforward recycling processes. This chart illustrates a notably demanding array of qualifications for an optimal storage material; as present, no material satisfies all of these criteria.

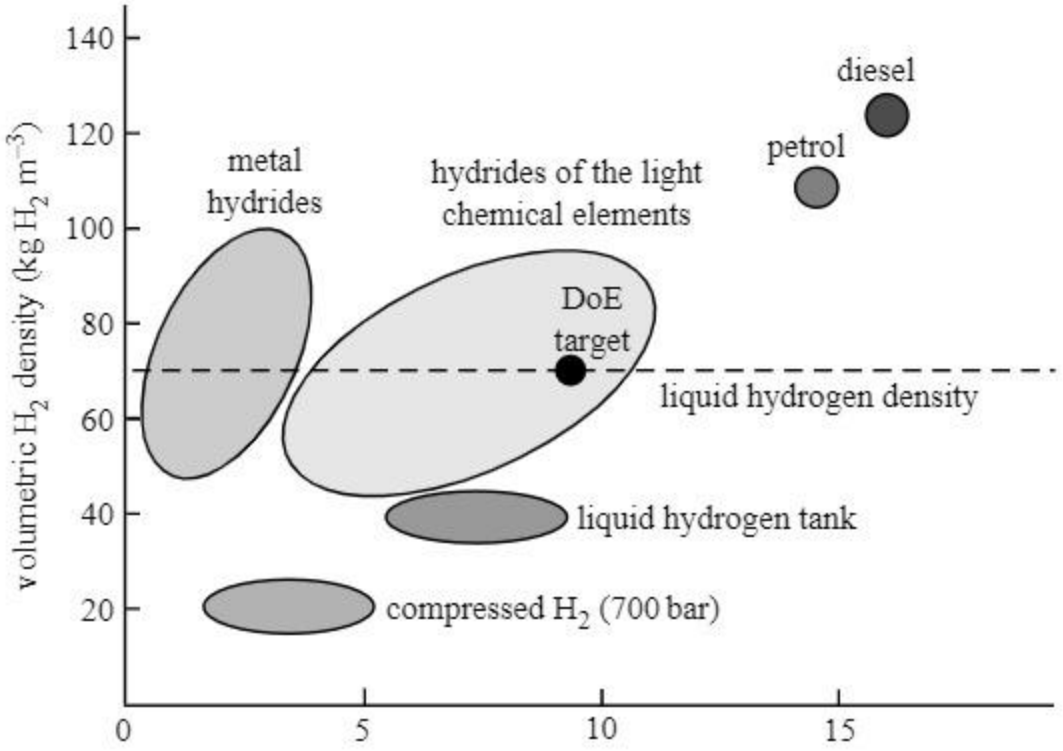

Figure 2. Gravimetric and bulk densities of various hydrogen storage options (note: the weight and volume of the storage container are included). The "DoE target" reflects the U.S. Department of Energy's target for the "ideal" hydrogen storage material for 2015. Metal hydrides are traditional, heavy metal hydrides, such as LaNi5, etc.

The inherent characteristics and behavior of hydrogen storage materials are contingent upon the specific nature of the hydrogen interaction with the host material. Various types of interactions exist, including:— physical adsorption of H2 molecules on the material's surface (either external or internal),— chemical absorption of hydrogen by the material resulting in the formation of chemical bonds (along with hydrogen dissociation), and— the creation of "chemical hydrides" distinguished by diverse covalent bonds. The physical processes that dictate hydrogen-material interactions are essential for the significant advancements required in this domain. Physical adsorption is the weakest kind of hydrogen bonding. Hydrogen molecules generally create a monolayer on the surface, necessitating a material with an exceptionally high surface area to attain a significant hydrogen storage capacity (Figure 4). A variety of high-surface-area materials have been examined, including zeolites, metal-organic frameworks, and several forms of carbon. The maximum hydrogen storage capacity is attained in carbon spheres processed with 8 wt% hydrogen. Nonetheless, effective hydrogen storage in carbon necessitates low temperatures (1968°C) and high pressures (up to 50 bar); furthermore, the ball milling process is protracted and energy-intensive.

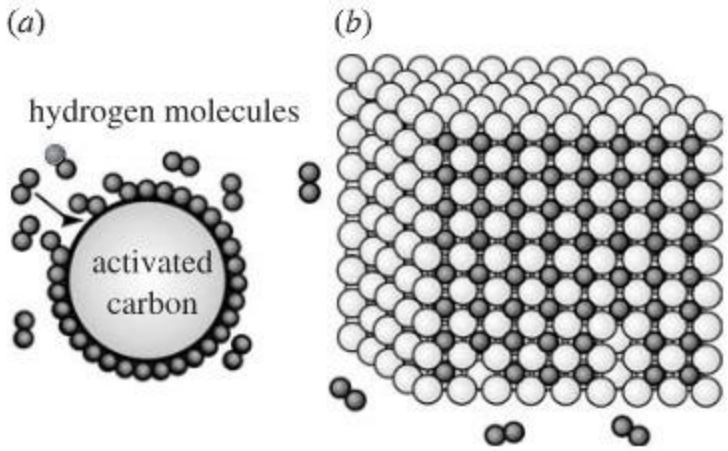

Figure 3. Schematic of (a) adsorption (physisorption) and (b) absorption (chemisorption) of hydrogen. In adsorption, hydrogen molecules remain intact; in chemisorption, molecular hydrogen dissociates and occupies interstitial spaces in the metal matrix (erosion).

The highest hydrogen storage capacity of chemically adsorbed hydrogen in prevalent metal hydrides (e.g., LaNi5H6, FeTiH1.7, MgNiH4) is approximately 4 wt%. These metal hydrides may securely and effectively retain hydrogen within their crystalline structure. Hydrogen is initially absorbed into the substance and subsequently released through regulated heating of the solid. Despite the increased bulk density of hydrogen in these materials compared to liquid hydrogen (Figure 2), the weight of the materials renders them impractical for on-board hydrogen storage in automobiles. Consequently, elevated gravimetric hydrogen densities can alone be attained by the hydrides of the lighter chemical elements in the periodic table. The most promising hydrogen storage materials are ionic-covalent hydrides composed of light elements, including lithium, boron, sodium, magnesium, and aluminum. [6] Hydrogen absorption and desorption in these materials often include high-temperature solid-state phase changes that were previously deemed irreversible; nevertheless, NaAlH4 appears to function as a reversible storage medium with appropriate catalysts. Recently, novel chemical pathways have been established to facilitate hydrogen uptake and release under mild conditions (Johnson 2005), and new promising hydrogen storage materials have been identified (Chater et al. 2006). Nevertheless, further fundamental study is essential to comprehend the physical and chemical processes that regulate hydrogen storage and release, as well as to enhance the hydrogen absorption and desorption characteristics of these materials to satisfy hydrogen storage demands.

CONCLUSION

Hydrogen energy presents a transformative opportunity for addressing the challenges of climate change, energy security, and sustainability. As the most abundant element in the universe, hydrogen offers a high energy density and the potential to replace fossil fuels across multiple sectors, including transportation, power generation, and industrial applications. However, realizing a hydrogen-based economy requires overcoming significant scientific, technological, economic, and infrastructural barriers.

The current reliance on fossil fuel-based hydrogen production methods, such as steam reforming, continues to contribute to carbon emissions, underscoring the urgency for cleaner alternatives like electrolysis powered by renewable energy. Advances in hydrogen storage, particularly in solid-state materials, will be essential for making hydrogen a viable energy carrier. Additionally, the expansion of hydrogen infrastructure, including production facilities, storage systems, and refueling stations, must be prioritized to facilitate large-scale adoption.

Despite these challenges, global investment and research into hydrogen technologies are rapidly accelerating. Governments, industries, and scientific communities are working collaboratively to develop cost-effective and sustainable hydrogen production, storage, and distribution methods. With continuous technological advancements and supportive policies, hydrogen has the potential to play a pivotal role in the global transition to a cleaner and more sustainable energy future.

While a full hydrogen economy remains an ambitious goal, the progress made in recent decades suggests that hydrogen will be an integral part of future energy systems. Continued innovation, investment, and policy support will be critical in ensuring hydrogen's successful integration into the global energy landscape, ultimately contributing to a low-carbon and sustainable world.

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Bioecological characteristics of plant species belonging to the genus Tulipa H. distributed in the territory of Sharur district, Nakhchivan MR

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Abstract: The bioecological characteristics of some plant species of the genus Tulipa H.—Humped Black Grouse Tulip, Florensky's Tulip, Julia's Tulip, and Two-flowered Tulip—distributed in the territory of Sharur district, Nakhchivan AR, have been studied. Extensive information is provided on the habitat and distribution area, as well as the form and method of reproduction of these species. The lifespan of the stem, leaves, flower, petals, and stamens of these species is also described. Additionally, information is presented on the inclusion of these plants in the "Red Book" for conservation purposes.

***Keywords**: plant, species, genus, season, family, seeds, perianth, stamen, "Red Book"*

INTRODUCTION

Biodiversity is essential for sustaining ecological equilibrium, but it is increasingly jeopardized by fast population expansion, urban development, industrial activities, and climate change. The interplay of these variables and anthropogenic environmental degradation has resulted in substantial modifications to natural landscapes. A significant consequence of these changes is the alteration of ecosystems, which jeopardizes the existence of plant and animal species. This problem is especially pronounced in areas with vulnerable natural systems, like as the Nakhchivan Autonomous Republic.

Nakhchivan, a crucial component of Azerbaijan, is situated in the Caucasus ecoregion, a worldwide acknowledged biodiversity hotspot. This region functions as a migration corridor for numerous species and hosts a rich array of endemic, uncommon, and relict flora. Nevertheless, owing to escalating human activity and environmental problems, numerous species are currently designated as vulnerable or endangered. The plant genus most impacted by these changes is Tulipa, encompassing species of considerable ecological and decorative significance.

The Tulipa genus, referred to as tulips, is found in Southern Europe, Central and Western Asia, and North Africa, with various varieties adapted to the distinct climatic and geological circumstances of Nakhchivan. These plants are especially vulnerable to habitat degradation, alterations in land use, and overexploitation, rendering their protection imperative. This study investigates the bioecological traits of various tulip species in the Sharur district of Nakhchivan, emphasizing their habitat, reproductive biology, and conservation status.

This article seeks to elucidate the survival issues faced by these tulips by examining their ecological requirements and distribution, so underscoring the necessity of conservation efforts. Due to the restricted populations and escalating threats to these species, prompt intervention is essential for their enduring conservation.

THE IMPACT OF POPULATION GROWTH AND ENVIRONMENTAL CHANGES ON FLORA IN THE NAKHCHIVAN AUTONOMOUS REPUBLIC

The rapid increase in the world's population and the resulting technogenic impact on the Earth have significantly altered natural landscapes, steering them away from their evolutionary course. These landscapes are increasingly being modified or transformed, placing their biological inhabitants in critical conditions. In transformed landscapes, the natural way of life for many species is disrupted, often forcing them to migrate elsewhere. When additional factors such as wars and the escalating production of toxic and radioactive substances are considered, the overall ecological situation for living organisms appears increasingly unfavorable.

The combined effects of natural and anthropogenic factors have led to serious changes in ecosystems, which serve as the primary habitats for plants. These changes have resulted in modifications to the plant kingdom, leading to the extinction of certain species, the classification of others as rare, and the transformation of plant phytocenoses in undesirable ways.

As an integral part of the Republic of Azerbaijan, the Nakhchivan Autonomous Republic is located along the migration corridor of species within the Caucasus ecoregion. This region is recognized for its rich biodiversity and is home to numerous rare, relict, and endemic plant species. Among the genera that include rare species in this region is the *Tulipa* genus.

FRITILLARIA GIBBEROSA BOISS. (HUMPED BLACK GROUSE TULIP)

Among the five species of this genus found in the Middle and Central Asian regions, only one species is present in Azerbaijan, specifically in the Nakhchivan Autonomous Republic. In Azerbaijan, it is distributed solely in the plains and foothill regions of Nakhchivan. It is a xerophytic plant that thrives on dry, rocky, clayey-gravelly slopes. Due to its limited distribution, its natural population is small. It reproduces both through seeds and bulbs.

This perennial bulbous plant has a globular bulb covered with loose scales. The stem reaches a height of 8-15 (20) cm, with glabrous leaves. The lower leaves are arranged in pairs, while the upper ones are alternately arranged, linear, and pointed. The flowers are located at the top of a raceme, with perianth segments that are purple, have dark violet veins, and feature a dark-colored base. These segments are ovate-oval in shape, measuring 12-18 mm in length and 7-9 mm in width, and they have small hairs. The anthers are purple-blue. The capsule is short-styled. Flowering occurs in April, and seed formation takes place in May. It is a geophytic ornamental plant belonging to the Iranian geographic range.

Due to its limited population and sensitivity to environmental changes, it faces significant threats, particularly from restrictive ecological factors in arid regions.

TULIPA FLORENSKYI WORONOW (FLORENSKY'S TULIP)

Out of 120 species of the *Tulipa* genus that are distributed in Southern Europe, Western and Eastern Asia, and North Africa, 12 species are found in the Caucasus, with 7 species present in Azerbaijan. In the flora of Azerbaijan, the Nakhchivan Autonomous Republic was initially recorded as having three species, but new findings have increased this number to seven. In Nakhchivan, this species is found around the Arpachay River and in the Karakush Mountain area, growing on rocky, gravelly slopes. Due to its restricted distribution, its natural population is limited. It reproduces through both seeds and bulbs.

The bulb is ovoid-elongated, with a diameter of 2 cm, covered with a gray sheath, and densely hairy inside. The stem reaches 10-15 cm in height, with 3-4 leaves. The solitary flower measures 2.5-4 cm in length, with petals that are flame-red (turning copper-red when dried). The inner base of the petal is dark-colored or black with a yellow border. The stamens are smaller than the perianth, with black filaments and yellow anthers that are shorter than the filament. The capsule is 3-4 cm long. Flowering occurs in April-May,

followed by seed production. This species is found in the lower and middle mountain belts and was originally described in Sultanabad, Iran. It is a geophytic ornamental plant belonging to the Atropatene geographical range.

As a sensitive species with a limited population, it is exposed to negative environmental impacts. The areas where it is found, including the Arpachay State Nature Reserve and the Karakush Mountain region, require special conservation efforts to protect its natural populations.

TULIPA JULIA C. KOCH (JULIA'S TULIP)

This species is endemic to the Nakhchivan Autonomous Republic and is found exclusively in the Karakush Mountain region of the Sharur district. It grows on dry, rocky, and limestone-rich slopes, occasionally near forest edges. Due to its restricted habitat and small population, its natural resources are limited. It reproduces through both seeds and bulbs.

The bulb is ovoid, with a diameter of 3 cm, and covered with a thin gray sheath. The stem reaches 15-35 cm in height and is glabrous. The plant has 3-4 leaves, each 3 cm wide. The solitary flower measures 4 cm in length, with petals that are flame-crimson-red, and the base is marked with a yellow-bordered dark spot. The filaments are black and glabrous. The capsule grows up to 3 cm in length. Flowering occurs in April-May, while seed maturation happens in May-June. It is a geophytic ornamental plant and a mesoxerophyte, classified within the Atropatene geographical range.

Due to its limited population and its value as an ornamental and food plant, it is affected by anthropogenic and zoogenic pressures. For its sustainable conservation, it has been included in Azerbaijan's "Red Book."

TULIPA BIFLORA PALL. (TWO-FLOWERED TULIP)

In Nakhchivan, this species is found in the Kur-Araz Lowland and the Kura Plain. Within the region, it occurs in the foothills and middle mountain belts, particularly in the Karakush Mountain foothills. It grows in dry grassy, clayey, gravelly, and rocky slopes. Due to its restricted distribution and small population, its natural resources are limited. It reproduces through seeds and bulbs.

The bulb is small, with a diameter of 1-1.5 cm, covered with a light-gray, membranous sheath, and internally lined with soft hairs. The stem is 7-17 cm tall, slender, and glabrous. The plant has two leaves, and the flowers are usually solitary, though sometimes two are present. The perianth measures 1.5-2.5 cm in length, with equal-sized, elliptical-lanceolate petals that taper to a point. The outer petals are pale violet or pale greenish-blue, while the inner ones are white or pale red, sometimes with fringed or bearded bases. The stamens are shorter than the perianth, with yellow filaments that are 2-2.5 times longer than the anthers. The capsule is 1-1.5 cm long. Flowering occurs in April, with seed maturation in May.

Due to its limited population, ornamental value, and the harvesting of its bulbs for consumption by local populations, it is exposed to significant environmental threats. Consequently, it has been included in the "Red Book" of the Nakhchivan Autonomous Republic.

CONCLUSION

The swift alteration of natural landscapes resulting from human expansion, industrialization, and environmental shifts has significantly affected global biodiversity. The Nakhchivan Autonomous Republic, as a distinctive natural zone, is not immune to these concerns. The region, which hosts many endemic and endangered plant species, is experiencing heightened pressure from natural and anthropogenic forces, resulting in habitat degradation, species alteration, and population decrease.

Tulipa is one of the most impacted plant genera in this region, encompassing species of considerable ecological, decorative, and genetic significance. The research emphasizes multiple tulip species—Fritillaria gibberosa, Tulipa florenskyi, Tulipa julia, and Tulipa biflora—that are significantly at risk owing to their restricted natural populations and susceptibility to environmental fluctuations. These species serve as indicators of the region's botanical richness and are essential for sustaining ecological equilibrium. Nonetheless, their survival is progressively jeopardized by alterations in land use, habitat degradation, overexploitation by humans, and climate-induced stressors.

The incorporation of these species in the "Red Book" of Azerbaijan and Nakhchivan underscores the immediacy of conservation initiatives. Nonetheless, simply categorizing species as endangered is inadequate. Conservation tactics must encompass proactive initiatives such as habitat restoration, the creation of protected areas, seed banking, and regulated cultivation in botanical gardens. Public awareness campaigns and educational initiatives must be undertaken to mitigate anthropogenic pressures, especially the harvesting of bulbs for ornamental and culinary uses.

Furthermore, scientific study and monitoring initiatives must be augmented to enhance comprehension of the ecological necessities and adaptive capacities of these species. Cooperation among municipal authorities, environmental organizations, and research institutes can promote the formulation of sustainable conservation policies. Establishing legislative frameworks to govern land use and avert additional degradation of vulnerable ecosystems will be essential for the long-term preservation of these tulip species.

The conservation of Tulipa species in Nakhchivan is both a botanical imperative and an ecological requirement. Preserving these plants entails maintaining a complete ecosystem that sustains diverse flora and wildlife. Without prompt intervention, the region jeopardizes not only its distinctive tulip species but also the diverse biodiversity that has characterized its natural heritage for ages. Effective conservation initiatives, supported by empirical research and community engagement, are crucial for reversing biodiversity decline and guaranteeing that future generations can appreciate the beauty and ecological importance of Nakhchivan's floral diversity.

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The Impact of Employees' Cultural Intelligence on Hospital Organizational Culture

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Abstract: Background and Objective: Organizational culture, as an important and fundamental part of an organization, affects all aspects of the organization, including goal setting, strategy, individual behavior, organizational performance, motivation and job satisfaction, creativity and innovation, the level of employee participation in matters, and the like, so that successful organizations have a strong and effective organizational culture.
Meanwhile, employees' enjoyment of cultural intelligence plays a significant role in strengthening organizational culture, and the relationship between these two variables has not yet been studied in hospitals in the country. In this regard, the present study aimed to investigate the relationship between cultural intelligence and its dimensions with organizational culture in Shahid Madani Hospital in Khorramabad.
Materials and Methods: The present study is a descriptive-correlational and cross-sectional study. The statistical population studied in this study is all employees of Shahid Madani Hospital in Khorramabad. Accordingly, 160 employees were selected by random sampling using the Morgan table. Ang and Denison questionnaires were used to measure cultural intelligence and organizational culture, respectively, and finally the collected data were analyzed using structural equation modeling and SPSS 26 and LISREL software.
Findings: The research findings showed that the relationship between cultural intelligence and its dimensions with organizational culture is significant. Among the dimensions of cultural intelligence, the cultural dimension has a stronger correlation with organizational culture with a coefficient of 0.65.
Ethical considerations: All matters related to the informed consent of the participants in the study to fill out the questionnaire and the confidentiality of the responses were taken into account.
Conclusion: The results showed that the ability of cultural intelligence to understand cultural factors outside the organization and to identify internal strengths and weaknesses is important. Therefore, considering the acquired nature of this ability, it is suggested that cultural intelligence be increased among hospital staff through formal training.
This requires that individuals be aware of the characteristics of other cultures and, by reviewing their own cultural knowledge, provide the context for extensive interactions between other cultures.

***Keywords**: Cultural Intelligence, Organizational Culture, Hospital Management, Employee Adaptability, Cross-Cultural Competence.*

1. INTRODUCTION

Today's organizational environment requires individuals who are able to adapt to the values and norms derived from the organizational culture. Organizational culture, taking into account the unique characteristics of the individual, shapes the beliefs, values, norms, and behaviors of organizational

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employees and facilitates the organization's achievement of its mission. Organizational culture is considered an important and fundamental part of an organization and is a social reality that is formed based on the unique interactions of organizational members Organizational culture is the product and result of the reciprocal or interactive relationship between the prejudices and principles accepted by the founders of the organization and what the members of the organization learn and will later adopt. Learning is established, so that each organization has its own unique culture that shows individuals how to understand and give meaning to events.

Studies show that organizational culture affects all aspects of the organization, including goal setting, strategy, individual behavior, organizational performance, motivation and job satisfaction, creativity and innovation, the level of employee participation in matters, and the like, so that successful organizations have a strong and effective organizational culture.[1]

From the perspective of Thomaidou et al. (2021), organizational culture provides the conditions for creating harmony outside the organization and harmony within the organization and acts as a social controller to reinforce certain behaviors and prevailing values.[2] Davidson et al. (2015) believe that organizational culture promotes the economic efficiency of companies, enhances the self-confidence and personal level of employees within the organization, creates a The incentive mechanism strengthens the communication structure and coordination within the organization and ultimately improves the performance and efficiency of the organization.[3]

Organizational culture is an environmental variable that affects all members of the organization to varying degrees. Therefore, a correct understanding of this structure is important for effective organizational management and work. Today, organizational managers have realized that in order to respond appropriately to the needs of the external environment and to coordinate and strengthen Internal processes require formal and even informal cultural training for new employees of the organization. Therefore, by having the necessary capacity to change and transform the organizational culture, it becomes possible to change the actions, thoughts, and feelings of a large part of the organization's members.[4]

Denison has introduced four basic cultural dimensions, which are:

1 - Participation: measured by three indicators of empowerment, team building, and capability development, and the values that arise from high levels of participation at work.

2- Consistency: In a culture of integration and consistency, communication is a very reliable process for exchanging information, because in this culture, there is a general agreement on the meanings of words, actions, and symbols, and in this case, a kind of common vision, beliefs, and shared values are created among the members of the organization, leading to increased coordination and the level of understanding and feeling of employees towards each other and towards the organization;

3- Adaptability: These are cultures that oblige the organization to adapt to changing demands and conditions. In fact, adaptability enables the organization to demonstrate better recognition and responsiveness to the organization's external and internal environment;

4- Mission: Based on the mission and the culture, it expresses the common definitions of the goals and tasks of an organization, which not only has a positive effect on investment and efforts to improve the

[1] Rahimi,et, al.2020.
[2] Pavlidou and Efstathiades,2021.
[3] Davidson,et, al.2015.
[4] Sokhanvar and Mosadeghrad,2017.

organization's situation but also helps to identify goals and strategies that facilitate the selection of the organization's paths of movement.[1]

Hospitals have a culture that is different from other organizations due to their mission, commitments, matrix structure, and technology, and this culture affects all aspects of it. Hospital managers' full awareness and understanding of organizational culture will lead to better leadership of organizational changes, and the success of a hospital's strategies is influenced by its cultural values. Ignoring organizational culture, beliefs, and values of individuals, if it does not lead to the absolute failure of the organization and failure to achieve goals and expectations, at least it creates many problems in the process of organizational movement and wastes a lot of energy in solving the problems created by confronting the anticipated goals with the prevailing culture of the organization.[2]

In their study, Sukhnour and Mosadgharad emphasized that organizational culture plays a critical role in hospital performance and attributed the successes and failures of hospital strategies to culture.[3] Saadati et al. used the Denison model to examine hospital culture. The results of this study emphasized the participatory nature of organizational culture.[4]

Runtu et al. (2019) examined the effects of organizational culture on organizational coordination in hospitals. This study, which was conducted as a systematic review, showed that organizational culture plays a key role in coordinating communication within work teams, managing conflict, and the level of authority and power in the organization.[5]) Understanding and addressing cultural differences among employees helps organizations achieve their goals. Studies show that some employees can adapt more effectively to their own culture and other cultures and better accept cultural diversity. Accordingly, the concept of cultural intelligence has entered the field of analyzing behavior and justifying the adaptation of individuals to each other and to the organizational culture, which means coordination and adaptation to different cultures; cultural intelligence is the most important tool that It can be used to deal appropriately with different cultures.

Cultural intelligence is one of the most effective tools for performing tasks effectively in culturally diverse environments such as hospitals. Cultural intelligence and its strengthening among hospital staff helps organizational values to be understood and accepted more quickly and makes organizational culture a leading factor in achieving its mission.[6]

The concept of cultural intelligence was first proposed by Earley and Ang, researchers at the London Business School. They defined cultural intelligence as the ability to learn new patterns in cultural interactions and to provide appropriate behavioral responses to these patterns.[7]

Cultural intelligence is a unique type of intelligence that is highly relevant to culturally diverse work environments. (2004) Peterson M. Cultural intelligence is defined as the ability to apply skills and abilities in different environments. Statistics show that many business failures occur when people from different cultures do not have a proper understanding.[8]

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[1] Sadeghi,et al. 2018.
[2] Ahmady,et, al.2016.
[3] Denison.et, al.2014.
[4] Bashokouh,el, al.2020.
[5] Runtu,el, al.2019.
[6] Altinay,et, al.2020.
[7] Earley and Ang,2003.
[8] Peterson,2016.

(Thomas et al., 2008) defined cultural intelligence as a system of interactive capabilities. In fact, cultural intelligence is a capacity that allows individuals to Have a good understanding of a wide range of cultures and act appropriately.[1] Gol and Erkin examined the relationship between cultural intelligence and cultural sensitivity in nursing students.

The results of this study showed that nursing students with higher levels of cultural intelligence were more sensitive to cultural understanding and established better relationships with people.[2] (18). (Eaglin et al., 2021) The importance of cultural intelligence in better leadership of nurses They know and consider it the reason for creating interest and motivation among all nurses .[3]

Research on cultural intelligence shows that this individual ability is acquired and increases through formal training and continuous interaction, so organizations can cultivate this important and vital ability for their employees.[4]

VanDyne and Ang have studied the measurement of cultural intelligence and its impact on adaptability, decision-making, cultural fit, and job performance. The results of this study showed that the dimensions of cultural intelligence are related to each of these variables, and in fact, cultural intelligence has been introduced as a predictive factor of these variables.

Thus, the two dimensions of cultural intelligence, strategy and knowledge, affect an individual's cultural judgment and decision-making. Also, the behavioral and motivational dimensions of cultural intelligence predict the degree of cultural adaptation of an individual to new cultural situations, and finally, the strategic and behavioral dimensions of cultural intelligence affect an individual's job performance.[5]

In this study, four components were used to measure cultural intelligence. Ang and colleagues consider cultural intelligence to consist of four components:

1. Cultural component: It is the way in which an individual reasons about cross-cultural experiences. This component of cultural intelligence considers the process that individuals use to acquire and understand cultural knowledge.[6] An example of this is when a person adjusts their concepts and mental images based on an actual experience that does not match their expectations.[7]

2- Cognitive component: It is an individual's awareness of the similarities and differences between cultures and reflects general knowledge about cultures (for example, information about religious and spiritual beliefs and values and beliefs about work, time, family relationships, manners and customs, and language);

3- Motivational component: The individual's confidence and trust in being able to adapt to the new culture. The motivational dimension of cultural intelligence includes the level at which individuals are confident and trusting in their abilities in intercultural interactions, the degree of openness to experience interactions with people from other cultures, and the degree of satisfaction they derive from those interactions;

4- Behavioral component: It indicates the individual's ability to display appropriate verbal and nonverbal actions in interactions with individuals from different cultures. This component of cultural intelligence focuses on how individuals act in situations in which they find themselves in a new culture (the individual’s

[1] Thomas,et, al.2008.
[2] Göl İ, 2019.
[3] Richard-Eaglin,2021.
[4] Ahmady,et, al.2016.
[5] Ang,et, al.2006.
[6] Ang,et, al.2006.
[7] . Beneroso and Alosaimi,2020.

overt actions), while behavioral cultural intelligence refers to the individual's ability to respond appropriately.[1]

Cultural intelligence is a concept that has received limited research. In light of the above explanations, the present study aims to investigate the relationship between cultural intelligence and organizational culture in Wazir Mohammad Akbar Khan Hospital, Kabul, and Jamhuriyat Hospital, and to determine what type of organizational culture medical staff with different levels of cultural intelligence prefer.

2. ETHICAL CONSIDERATIONS

The completion of this questionnaire was done with the full consent of the respondents, and the participants were assured that their answers would remain confidential. In general, the principles of ethics in the research were observed in accordance with the guidelines of the Code of Ethics in Medical Sciences Research.

3. MATERIALS AND METHODS

The present study is a cross-sectional descriptive-correlational study with a meta-empirical paradigm. The statistical population included all employees of Wazir Mohammad Akbar Khan Hospital in Kabul and Jamhuriyat Hospital, totaling 305 people. The Morgan table was used to select the statistical sample.

According to this table, 169 people were proposed as a sample. In this regard, in the present study, 175 questionnaires were distributed among hospital employees, and 160 of them were returned and analyzed. It is worth mentioning that due to the availability of members of the statistical community, a simple random sampling method without replacement and by drawing lots was used.

For this purpose, 175 cards were initially prepared and after numbering and assigning a number to each of the sample members, a number was randomly selected from these and the questionnaire was given to the individual in question. The data collection tool in this study was a standard questionnaire.

In this study, in order to investigate the relationship between cultural intelligence and organizational culture, the necessary information was collected through Ang et al.'s (2007) 18-question questionnaire to measure cultural intelligence and Denison's 45-question questionnaire to measure organizational culture.

The scale of the questionnaires for cultural intelligence (with cognitive, cultural, motivational and behavioral dimensions) and organizational culture (with mission, coherence, participation and adaptability dimensions) is a 5-point Likert scale. The validity of the cultural intelligence questionnaire was determined and confirmed using the opinions of professors related to the research topic. It was also determined through construct validity that all questions have a reasonable correlation with their latent variables. In the construct validity according to Holland (1999), the factor loading of all the variables measuring indices should be above 0.4.

According to Figure 1, which shows the research model in the standard measurement mode, the factor loading of all the cultural intelligence measuring indices was above 0.4, which indicates the confirmation of the construct validity of the research questionnaire.

Regarding the reliability of the entire cultural intelligence questionnaire, this value was 0.81, which indicates a good and appropriate reliability of this questionnaire. In order to examine the validity of the organizational culture questionnaire, 15 questionnaires were distributed among professors and specialists, and all ambiguities regarding the questions were clarified and removed.

[1] Zaman and Aktan,2021.

Also, confirmatory factor analysis (construal analysis) indicated a very high correlation of the research questions according to Figure 1 (above 0.5) with the latent variables, and the Cronbach's alpha value for the organizational culture questionnaire was 0.87, which indicates the appropriate reliability of the questionnaire in this study. In this study, the structural equation model was used, so that the relationships between cultural intelligence and organizational culture were determined through the standardized coefficient and a significant number with LISREL software was used to evaluate and based on it, decisions were made regarding the confirmation or rejection of the hypotheses.

In total, first-order and second-order factor analysis (measurement models) and path analysis (structural model) were used. In this order, first-order and second-order factor analysis were used for the concept of cultural intelligence and first-order, second-order and third-order factor analysis was used for the concept of organizational culture (for validity). questions) was conducted, then through path analysis, the relationship between cultural intelligence and organizational culture was measured.

4. FINDINGS

Analysis of the demographic characteristics of the respondents showed that 121 of the respondents were male and 39 were female. In terms of organizational position, 11.9% were physicians, 64.4% were paramedics, and 21.7% were administrative staff.

4.1 Community Mean Test: A community mean test was used to examine the status of the research variables. According to this test in Table 1, the significance level for most of the above variables is less than 0.05 and is greater than 0.05 only in the cognitive variable, in which case the null hypothesis ($\mu \leq 3$) was rejected for all variables except for cognitive and the null hypothesis ($\mu > 3$) was accepted. Also, considering the negativity of the upper and lower limits for the cognitive, motivation, behavior, cultural intelligence and organizational culture variables, it can be said that the status of these variables in The hospital under study is not suitable.

4.2 Hypothesis Testing: In this section of the study, the relationship between cultural intelligence variables and organizational culture is measured using Pearson correlation. If the significance level is less than 0.05, the null hypothesis (no relationship between the variables) is rejected and the null hypothesis (the existence of a relationship between the variables) is accepted. As the results of Table 2 show, the existence of a relationship between the components of Cultural intelligence was confirmed with organizational culture and the research hypotheses were accepted. After ensuring the validity of the measurement models (confirmatory factor analysis of the concepts of cultural intelligence and organizational culture), the main research hypotheses were tested. In other words, the relationship between cultural intelligence and organizational cultures was measured together and the research model was estimated in the standard mode (standard coefficients) and the coefficients The significance (significant number) is discussed (Figures 1 and 2).

As Figures 1 and 2 show, ( ) is less than 3 and also the value of GIF index as one of the goodness-of-fit criteria is 0.92. The RMSEA index is acceptable if it is below 0.8 and if it is below 0.5, it indicates a very good fit. According to the software output, for the present study, this rate was 0.06, which indicates a very good fit of the research conceptual model, so the obtained values indicate that the research conceptual model has a very good fit.

The results of the model fit indices are listed in Table 3. Based on the results of Table 4, the relationship between cultural intelligence and its dimensions on organizational culture, on the other hand, structural equations in the standard and meaningful estimation mode, confirm the effect of cultural intelligence and its dimensions (cultural, cognitive, motivational, and behavioral) on organizational culture. In other words, the higher the level of cultural intelligence of employees, the greater the acceptance of organizational

culture among individuals, which in turn leads to increased job satisfaction, job engagement, and organizational commitment.

5. DISCUSSION

The main question in the present study was whether the cultural intelligence of employees has an effect on the organizational culture of Wazir Mohammad Akbar Khan and Jamhuriyyat Kabul hospitals? The results showed that all four dimensions of cultural intelligence (cultural, cognitive, motivational, and behavioral) have a positive and significant relationship with organizational culture.

This relationship is important because the existence of high cultural intelligence leads to a complete understanding of the organization's goals and objectives, strategic vision and goals, coordination and coherence, and awareness of customer needs in the form of work teams.

Therefore, considering the hypothesis test conducted, the concept of the relationship between the variables is as follows: The existence of a relationship between the cultural dimension of cultural intelligence and organizational culture was confirmed. Having this element of cultural intelligence allows individuals to adjust their mental experiences of culture to new circumstances and thus understand cultural differences .[1]

The relationship between the cognitive element and organizational culture was confirmed. The possession of this characteristic helps individuals recognize similarities and differences between cultures and reflects general knowledge about cultures (for example, information about religious and spiritual beliefs and values and beliefs about work, time, family relationships, manners and customs, and language).

Another finding of this study was the relationship between the motivational component and organizational culture, which was confirmed based on the results obtained. This ability enables the individual to adapt to a new culture and reduces interpersonal friction between people from different cultures. The behavioral component also had a positive and significant relationship with organizational culture. A prerequisite for complete and unobstructed communication is the ability of individuals to use verbal and non-verbal expressions appropriately.

Enjoying the behavioral component of home is the appropriate use of this category at the appropriate time. Also, based on the analytical findings of the study, it was determined that the level of cultural intelligence components among the employees of Ibn Sina Sadri Hospital is low, which is generally due to the fact that the ability of cultural intelligence as a very important ability in understanding cultural factors outside the organization and identifying internal strengths and weaknesses is insignificant. Therefore, considering the acquisition of this ability, it is suggested to develop cultural intelligence among employees through formal training. Hospital staff should be educated. This requires that individuals be aware of the characteristics of other cultures and, by reviewing their own cultural knowledge, provide a context for extensive interactions between other cultures. Also, continuous interactions at the international level and international travel, activity in multinational groups and teams, and training new teachers in intercultural interactions with up-to-date knowledge are other ways to increase this ability.

The improvement of cultural intelligence should be carried out within the framework of the organization’s comprehensive strategic human resource development program and in addition to other aspects of this program, and should benefit from the advice of competent individuals such as professional psychologists and teachers. Among these methods of developing and strengthening cultural intelligence is the step-by-step approach proposed by Early and Mosakowski (2004).[2]

[1] Askari and Rahmati,2020.
[2] Earley and Mosakowski,2004.

According to these two researchers, in order to strengthen cultural intelligence, after measuring this type of intelligence in individuals and determining their strengths and weaknesses, the necessary training program should be selected. That is, if the individual's cultural-behavioral intelligence is at a lower level, he should participate in training related to behavior, and or if he is weak in the cognitive or scientific dimension, the individual's inductive and deductive reasoning can be developed.

The results of the present study are consistent with the research of Van Dyne et al. (2007) and Eaglin et al. (2021). In the Van Dyne study, it was found that the dimensions of cultural intelligence are related to adaptability, decision-making, cultural fit, and job performance.

6. CONCLUSION

In the present article, all four dimensions of cultural intelligence (cultural, cognitive, motivational, and behavioral) had a positive and significant relationship with organizational culture. According to the respondents, the level of cultural intelligence components among the hospital staff under study is low, which in turn is an evidence of the weakness of understanding the organizational culture of the hospitals.

Accordingly, formal training to strengthen cultural intelligence and create broad interactions for hospital staff is essential. In the present study, it was also stated that the dimensions of cultural intelligence are necessary for cultural fit and effective communication with people inside and outside the organization.

In comparison with the research of Eaglin et al., which examined, The development and quantitative measurement of cultural intelligence at the organizational level and among nurses were identified in both studies as a vital factor and an important predictor of employee and organizational performance. In this regard, the results of this study are consistent with the research of Gol and Erkin (2019), who stated that the cultural intelligence of nursing students enhances their skills in understanding cultural values and communication. It is consistent between individuals.

Table 1: Average test of a community

Variable Name	Average	standard deviation	0/0001 <	Lower limit	Upper limit	Variable status
Culture	4563/2	0.66561	0/674	-0.6477	- 0.4398	Inappropriate
Cognitive	9763/2	0.71335	0/0001 <	-0.1351	- 0.0876	Average
Motivational	5788/2	0.82891	0/0001 <	0.5507	- 0.2918	Inappropriate
Behavioral	7300/2	0.91506	0/0001 <	-0.4129	- 0.1271	Inappropriate
Cultural Intelligence	6853/2	0.51718	0/0001 <	-0.3970	- 0.2324	Inappropriate
Organizational Culture	6851/2	0.67116	0/0001 <	-0.4197	- 0.2101	Inappropriate

The limitations of the present study are that this study was conducted in only one hospital, which limits the generalizability of the findings. In this regard, it is recommended that future researchers conduct the present study in other hospitals and compare its results with this study.

Table 2: Examining the existence of a relationship between research variables

Variable	Dimensions	Organizational Culture	The existence of a connection	Type of connection
Organizational Culture	-	1	.	.
Cultural Intelligence	Cultural	0/26	has	Direct
	Cognitive	0/333	has	Direct
	Motivational	0/189	has	Direct
	Behavioral	0/276	has	Direct

The significance level is less than 0.05.

Table 3: Extent of research measurement models

Indicators		RMSEA	CIF	CIF	AGIF
Values	2.781	0.920	0.927	0.66	0.870

Table 4: Results from the structural equation model (path analysis)

Hypothesis	Path	Standardized coefficient		(t-statistic)
Main	Cultural Intelligence	Organizational Culture	0.52	35/5
Sub 1	Cultural	Organizational Culture	0.65	6/88
Sub 2	Cognitive	Organizational Culture	0.57	6/09
Sub 3	Motivational	Organizational Culture	0.45	4/63
Sub 4	Behavioral	Organizational Culture	0.46	4/77

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Review And Importance of International Legal Dimensions of The Use of Artificial Intelligence in Space Technologies

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With the remarkable developments in space technologies, artificial intelligence has gradually been used instead of humans in decision-making. Artificial intelligence has the ability to think logically, manage its own actions, and correct decisions in the event of changes in external conditions. New smart space technologies are being developed to perform various space activities such as processing space data and information, removing space debris, extracting natural space resources, and exploring without human intervention. However, the regulation of the activities of space actors, especially private actors, and the supervision of these activities by governments in the use of these types of technologies has become one of the new issues in the field of international space law.

Since the obligations of States within the framework of international space law are explained on the basis of human behavior, in the face of monitoring the performance of intelligent space technologies and compensation for damage resulting from their performance, the question arises as to whether the existing international space regulations on the international responsibility of States for monitoring space activities and compensation for damage, which are based on human behavior, can also be applied to the use of these technologies, or should the regulations be A new space law should be drafted. With a broad interpretation of Articles 6 and 7 of the 1967 Outer Space Treaty regarding the responsibility of States for monitoring space activities and also the responsibility for compensation for damage, these provisions can still be considered applicable.

Nevertheless, it seems that the development of new international space regulations could be an important step in better defining and recognizing the responsibility of states to monitor the use of intelligent space technologies by space actors and to compensate for damages resulting from it.

***Keywords**: International Law, Artificial İntelligence, Space Technology, Liability.*

INTRODUCTION

Artificial intelligence is a computer system that operates to some extent similar to the human mind and includes cognitive technology that imitates the human mind. To the extent that artificial intelligence can make decisions for humans, the role of the human agent becomes less important. Therefore, with the development of the use of artificial intelligence in new technologies, including space technologies, human intervention in decision-making has gradually decreased and artificial intelligence has gained the ability to make decisions instead of humans in various situations. (Abashidze et al., 2022, p. 1).

Since the beginning of space activities, from the 1960s until now, the use of space technologies such as spacecraft and satellites or the use of space robots in the extraction of natural resources from celestial bodies has usually been carried out by astronauts who have human intelligence and behavior. However, in recent years, there have been remarkable developments in space technologies, especially satellite systems and space-based services, in which artificial intelligence is used to make decisions instead of humans. Since the nature of spacecraft provides a suitable platform for the development of artificial intelligence, and almost all space activities such as remote sensing and remote communications have the ability to use artificial

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intelligence, modern intelligent space technologies are currently being used for space debris removal, natural resource extraction in space, and exploration.

By using these technologies, better services in various fields, including transportation, smart city management, ensuring national and cyber security, agricultural services, and monitoring climate change, are provided to the public.

Despite the benefits of using artificial intelligence in space technologies, with the expansion of intelligent space-based services, new challenges have emerged in the field of space activities. The use of technologies equipped with artificial intelligence, for the purpose of exploring outer space and also participating in commercial space applications and services, will create unintended consequences regarding the obligations and responsibilities of States.

These consequences arise from the correct or incorrect use of such technologies and cannot be ignored. It is possible that due to inefficiency in the functioning of artificial intelligence, which makes decisions independently of humans, damage to life and property of people on Earth or in space could occur. Also, the use of space-based applications equipped with artificial intelligence increases the possibility that the rights related to the privacy of individuals will be violated or the security of citizens will be jeopardized.

With the increase in the volume of data, spatial information and its processing through artificial intelligence, a lot of information is becoming widely available to the public. Among this information and data, confidential(or private information of real and legal people may also be disclosed without their consent. (Martin & Freeland, 2020 : 278)

Whereas the issue of State oversight of space activities and compensation for damage is clarified in international space law and the responsibility to prevent the commission of an internationally wrongful act under Article 6 and the responsibility to compensate for damage under Article 7 of the Convention on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Activities of 1967 (the Outer Space Treaty) requires a connection between the oversight and the damage. and damages caused by human behavior have been proven, the question arises whether the responsibility for monitoring the activities of space actors, including private actors, can be specified and determined based on these regulations, while human behavior will be reduced or completely ineffective with artificial intelligence decision-making.

In this article, current international space law and the possibility of applying international regulations to the challenges posed by the use of artificial intelligence in determining the responsibility of states for Supervision and compensation will be considered.

With a broad interpretation of these articles, with regard to the competent State, responsibilities for space activities in space technologies that use artificial intelligence can also be determined for States. Also, clarifying the responsibility of contracting states in the use of space technologies, which use artificial intelligence, in treaty law could be an important step in international space law.

INTERNATIONAL SPACE LAW APPROACH USING ARTIFICIAL INTELLIGENCE

In general, the development of artificial intelligence in space technologies currently faces a lack of enforceable international regulations and has not yet been explicitly and directly addressed within the framework of space “hard law” and “soft law.” Space “soft law,” which has played a significant role in regulating space activities in recent years, has not provided regulations or guidelines for dealing with states regarding liability for the use of artificial intelligence in space technologies. Although in 2018, issues related to the use of artificial intelligence technologies in space were raised as part of the activities of the Committee

on the Peaceful Uses of Outer Space (COPOS), and the topic of the work order for this year was specifically the use of artificial intelligence for processing satellite images, the examination of this issue was removed from the work order of this Committee without any concrete results or legal achievements. Since then, the topic of artificial intelligence has not been included as a separate and independent topic in the COPUS agenda (Report of the Committee on the Peaceful Uses of Outer Space, 2018).

Space activities are governed by the "hard law" of space, which has already been adopted by the United Nations in the framework of five international treaties. Of these five treaties, four are international space treaties, namely the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, 1967 (Outer Space Treaty), the Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Abandoned in Outer Space, 1968, and the Convention on International Liability for Damage Caused by Space Objects, 1972 (Liability Convention (1972) and The Convention on Registration of Objects Launched into Outer Space, 1974 (Registration Convention, 1974) have been implemented, and the fifth treaty, the Agreement Governing the Activities of States on the Moon (and Other Celestial Bodies, 1978), has not yet been implemented, despite the passage of more than 45 years since its ratification. (Masson-Zwaan & Mahulena, 2019: 32) .

These five treaties contain explicit provisions on the use of artificial intelligence technologies. They are not binding and only state general principles for all space activities. In general, these general principles and rules mainly concern the following:

(1) The exploration and use of outer space shall be for the benefit of all States.

(2) Space shall not be subject to the national occupation and possession of any State, and space activities shall be conducted in accordance with international law.

(3) Space activities should be conducted based on the principle of cooperation and the obligation to take into account the interests of other States in this regard.

(4) States should inform the public and the scientific community of the nature, course, locations and results of their space activities.

(5) States are responsible for all national activities in the international arena and towards other States and, in the event of damage, must make reparation for the damage.

Among the aforementioned principles, since the principle of responsibility In the absence of explicit and transparent provisions on AI issues in space technologies, especially in the area of liability, it can be argued that the starting point of the legal challenge should be the use of AI to align the rules and principles of liability with the performance of AI.

The use of AI systems in space activities will cause gradual changes in human analysis and selection. With the help of computers and computer-assisted selection, humans have become capable of analyzing and analyzing information and automating machines without the need for human performance and making decisions and implementing them independently by artificial intelligence. (Cuellar, 2017: 30)

CHALLENGES OF INTERNATIONAL SPACE RESPONSIBILITY

The deployment and use of artificially intelligent space objects by new space actors in space has raised the issue of how to assign international responsibility to contracting states; Because the principles of liability in these treaties on issues such as surveillance of space activities, compensation for damage to property and persons, and ultimately the disclosure of data and information of individuals and the violation of their privacy in space activities based on human-centered behavior, their application to behavior based on

artificial intelligence requires new examination (Stewart, 2019: 2). To respond to this new challenge, it is necessary to first examine existing international space law. It should also be clarified whether existing international rules on liability are also applicable to the consequences of the use of artificial intelligence.

LIABILITY FOR THE SUPERVISION AND REGULATION OF SPACE ACTIVITIES

The 1967 United Nations Outer Space Treaty recognizes States as internationally responsible for space activities. Article 6 of the Outer Space Treaty states that "States Parties to the Treaty have an international responsibility with respect to national activities in outer space, including the Moon and other celestial bodies, whether such activities are carried out by governmental agencies or non-governmental entities, and to ensure that national activities are carried out in accordance with the provisions set forth in the present Treaty." Activities of non-governmental organizations in outer space, including the moon and other celestial bodies, should require the authorization and continuous supervision of the appropriate State Party to the Treaty. Whenever an international organization carries out activities in outer space, including the moon and other celestial bodies, the responsibility for compliance with this Treaty shall lie with that international organization and with the States Parties to the Treaty participating in that organization.

According to Article 6 of the Outer Space Treaty, it is the international responsibility of States to supervise space activities, whether these activities are carried out by a State or by a private entity under the jurisdiction of a State. Two essential elements, namely the issuance of the necessary permits and the supervision of space activities, play a fundamental role in attributing responsibility to States. The activities of private companies in outer space will require authorization from and continuous supervision by a Contracting State that has the necessary authority for this responsibility.

In fact, States have been recognized as the main players in space activities, regardless of whether the space activities are scientific or commercial in nature and whether they are governmental or private. States that are parties to the Treaty undertake to issue licenses for the space activities of their companies in accordance with national laws and to continuously monitor their performance. (von der Dunk, 2015: 1)

On the one hand, it follows from Article 6 of the Outer Space Treaty that States are obliged to monitor the performance of their public and private sectors based on the occurrence of unlawful conduct and internationally wrongful acts. International law is violated by any Contracting State when space activities of its public or private entities are carried out without a valid license or when the Contracting State does not maintain continuous surveillance of space activities.

On the other hand, it is inferred from the contrary meaning of this article that a State that properly and effectively implements a licensing and surveillance regime for its domestic entities is not held responsible. Therefore, the non-realization of the responsibility of a Contracting State is provable when it is proven that, despite the necessary supervision of space activities by the State, the activities that have resulted in damage have been carried out by the private sector illegally and without authorization in the territory of that State or under the jurisdiction of a third State.

It is also inferred from Article 6 of the Outer Space Treaty that the doctrine of wrongful act allows a claim of liability against a State that has failed to perform its obligation to authorize and supervise space activities under its jurisdiction, even if no damage has been caused. Under this article, sufficient evidence is found for the international responsibility of a State that authorizes space activities under its jurisdiction without proper and reasonable supervision. Therefore, the space law treaty regime does not impose any direct obligations on non-governmental entities.

In return, it assigns all responsibilities and obligations to space actors, i.e., states, and states that the space activities of non-governmental organizations are subject to limited oversight by states, and that the treaty

regime does not apply directly to the private sector. Therefore, if space actors do not conduct space activities under the supervision of their own state and instead conduct space activities under the authority of a third state, the question arises as to which state—the actors' own state or the third state—bears international responsibility for these private space actors. (Cheng, 1995: 307).

In international space law, regarding liability for compensation for damage or liability for registration of a space object, the launching State is recognized as the responsible State in the 1972 Liability Convention and the 1974 Convention on Registration of Space Objects, respectively. However, this term is not used in Article 6 of the Outer Space Treaty, which deals with the supervision of space activities. This article refers to the "appropriate State or competent State" and requires it to ensure that the space activities of its governmental and non-governmental entities are in accordance with the Outer Space Treaty.

Since neither this article nor any other article of the treaty regime on space law defines the term "competent State", there is no agreed legal standard for determining the "competent State". Of course, with a narrow interpretation based on the two Liability Conventions and the Registration Convention, the launching State can be considered the competent State, while with a broad interpretation, the competent State can be extended to States that are more suitable for supervising their subordinate institutions, even though they are not the launching State. (Cheng, 1998: 7).

The competent State, whether the launching State or another State, is responsible under the surveillance standard of "observance and negligence". The Contracting State must also exercise its responsibility for surveillance of the intelligent space object under the surveillance standard.

The State responsible has the duty to ensure that it has issued the necessary authorization for an intelligent space object launched by a non-State entity and has exercised appropriate supervision over its activities, regardless of whether it is owned or operated by one of its nationals. Therefore, by analyzing the standard of care of the occurrence of a specific event that caused the damage, the answer to the question of whether the competent State has issued the necessary permits for the activities carried out by the intelligent space object and has exercised sufficient supervision over it or not is different.

Here, if a state's public or private sector plays a role in the use of artificial intelligence in space technology and is not the launching state, then this state can also be held liable based on a broad interpretation, even though it is not the launching state. However, if only the launching state is held liable at the international level, new rules should be established in space law. (Dennerley, 2018:281).

Therefore, compliance with the standard of due diligence by an authorized State requires that that State ensure the issuance of authorization and supervision of space activities carried out using an intelligent space object. The subject of compliance with this standard is the provision of a flexible standard in space law. The commitment to "due diligence" is not a commitment to achieve a specific result. Rather, it is a behavioral and instrumental obligation that requires a contracting state to make sufficient and necessary efforts to prevent loss or injury to another state or its nationals.

The breach of this duty is not limited to the actions of the state but also includes the behavior of its nationals (Messerschmidt, 2013:303). However, based on flexible standards of supervision, it appears that the performance of an intelligent space object determines whether or not human intervention or supervision is required and, if so, what is the appropriate degree and extent of such supervision.

The flexibility of the standard of supervision is in line with the approach generally recognised by the European Commission (EC) on AI (European Commission, White Paper on Artificial Intelligence, COM, 2020). The EU's position is that human supervision is a necessary component of the use of AI, arguing that

human supervision ensures that "the AI system does not undermine human autonomy or create other adverse effects."

"Human oversight" requires appropriate human(s) participation, which may vary depending on the "intended use of the AI system" and its impact on individuals and legal entities, if any. The European Union has also identified some manifestations of human oversight in the use of AI, including:

(1) Review and validation of AI decisions before or immediately after the decision is made.

(2) Supervision of the AI system while it is operating and the ability to intervene in real time and deactivate the AI system.

(3) Implementation of operational constraints to ensure that certain decisions are not made by the AI system. Artificial.

According to the above, the European policy on providing a flexible framework for the specific issue of artificial intelligence in space technology could be a model for future use in international space law. This approach determines whether the competent State's performance complies with its standards of oversight in the case of a non-state intelligent space object that has caused harm in outer space. The standard of "oversight" could be assumed to be necessary" and adopted oversight for the liability of the armed State for damage caused by an intelligent space object.

This flexible standard allows the launching State, which is held liable in contractual cases, to argue that the home State of the non-State space actor has a greater role and responsibility than the launching State. Accordingly, the launching state can deny liability on the grounds that the state whose citizens play an active role in the use of intelligent space objects should exercise due diligence in issuing adequate permits and oversight.

This shifts the oversight obligation from the launching state to the country of the main non-state space actor. Failure by the State of the space actor to properly implement the standards of care in this regard may, depend on the circumstances, result in the exemption or reduction of the liability of the launching State.

LIABILITY FOR COMPENSATION

According to Article 7 of the Outer Space Treaty, in the event of damage caused by space activities, the damage must be compensated by the responsible State to the injured State. Article 7 of the Treaty states that "any State Party to the Treaty which launches or causes to be launched an object into outer space, including the moon and other celestial bodies, and any State Party from whose territory or installations an object is launched, shall be liable for damage caused by the said object or its constituent parts on the earth, in the air or in outer space, including the moon and other celestial bodies, to any other State Party to the Treaty or to its actual or legal nationals." International opinion bears responsibility.

The basic rules in Article 7 of the Outer Space Treaty of 1967 on liability for damage are set out in detail in Articles 2 and 3 of the Convention on International Liability for Damage Caused by Space Objects of 1972. However, Article 7 of the said Treaty is very general and does not specify on what basis compensation should be awarded. According to the wording of Article 7 of the said Convention, it is inferred that the launching State bears absolute responsibility.

The above-mentioned Liability Convention has explained the subject of liability for compensation for damage in a comprehensive manner and has separated the basis of liability for damage caused in outer space from damage caused on the ground and in the air, and has made the criteria for establishing liability the

place of occurrence of the damage, i.e. the surface of the earth and the air above the earth on the one hand, and outer space, such as orbits or celestial bodies, on the other hand. (Lee, 2003: 4).

Article 2 of the 1972 Liability Convention states that "the launching State shall be absolutely liable for damage caused by its space object to the surface of the earth or to aircraft in flight." Furthermore, Article 3 of the Convention expressly states that "Where damage is caused in a place other than the surface of the Earth to a space object of the launching State or to persons or property on board that space object by a space object of another launching State, the latter State shall be held liable if the damage is caused by the fault of that State or by the fault of persons for whom it is responsible."

According to the above two articles of the Liability Convention, liability based on strict (or specific) liability for damage caused by a space object to property and life on the ground or to aircraft in flight, and liability based on fault for damage caused by a spacecraft in outer space or to a celestial body such as the moon, has been formally recognized. Furthermore, the Convention emphasizes that the responsibility for compensation for damage lies solely with States, because non-state actors cannot be held accountable under international space law.

With the development of space technologies and the use of artificial intelligence in them, the potential for activities in the dangerous environment of outer space has become even more complex, such that the attribution and enforcement of liability for damage resulting from the use of space technologies, which use artificial intelligence, is challenged on the basis of Articles 2 and 3 of the Liability Convention.

Attribution to artificial intelligence should replace attribution to the behavior of individuals who have played a role in the breach of obligation and liability, and the question will arise as to whether the provisions contained in the Outer Space Treaty and the Liability Convention can also be applied to breaches of obligations and damage caused by artificial intelligence.

Absolute Liability

According to Article 2 of the Liability Convention, if a space object causes damage to persons or property on the surface of the earth or to aircraft in flight, absolute liability lies with the launching State. By accepting the principle of absolute liability, which usually deprives the responsible individual of any right of defense, there is no difference between damages resulting from an artificial intelligence decision and damages resulting from human behavior, and the launching state must compensate for the damage caused without resorting to the right of defense. However, the Liability Convention still recognizes the right of the launching State to "effectively compensate for damage caused by the negligence, fault or recklessness of the injured party".

According to Article 2 of the Liability Convention, launching States are fully liable for damage caused by their space objects on the surface of the Earth. At the same time, in these circumstances, there is no obstacle to the legal prosecution of countries that use artificial intelligence technologies and are not the launching state. The complexity of the issue becomes apparent when such liability is established within the framework of Article 6 of the Liability Convention, which states the abolition of the strict rule of Article 2. This article states that if "the launching State establishes that the damage was caused in whole or in part by gross negligence or by an act or omission of the claimant State or of natural or legal persons acting on its behalf with intent to cause damage", the claimant State cannot rely on the damage caused by the claimant State, since the claimant itself played a significant role in causing the damage.

The effective exemption from liability for damages in respect of a space object equipped with artificial intelligence is practically impossible, since gross negligence is conduct that occurs by a human being and not a machine. The concept of "gross negligence" is not defined by the Convention and only refers to the

“standard of care”. Some scientists conclude that "gross negligence" is, above all, a personal criterion and the result of the activity of the human mind, which in principle cannot be matched by the characteristics of a machine. Therefore, in the absence of clear criteria for expressing the "standard of care" and taking into account the fact that it has been established depending on the level of scientific and technological progress, the implementation of the relevant provisions in the Convention on Liability for Space Technologies Using Artificial Intelligence is accompanied by great complexity, and it seems that new rules should be established in international space law.

LIABILITY BASED ON FAULT

Article 3 of the Convention establishes liability for various activities in outer space as being based on fault but does not provide a definition of the concept of “fault”. There are no clear criteria for assessing fault, and States have broadened or narrowed this definition based on their own legal systems. It is relatively difficult to prove fault in the event of a collision between two spacecraft in outer space, and so far, no known case of damage in outer space due to a collision between spacecraft has been cited under the Liability Convention (Long, 2014: 8).

Now, the extent to which the use of artificial intelligence has led to damage and injury in outer space must be added to the difficulty of using artificial intelligence in technology in the event of a collision between two spacecraft. If the limits and scope of the interference of artificial intelligence are determined and its interference is less than the usual limit, the state that controls the spacecraft will be held liable under the Liability Convention. In other words, it is important to determine at what stage and to what extent artificial intelligence has been used in such technologies in the implementation of space operations.

Damages resulting from decisions made by AI or arising from data generated using AI technologies should be eligible. This depends on determining the extent of the direct and substantial impact of AI on space activities. The term “persons” used in Article 3 of the Liability Convention also raises questions regarding the use of AI in space technologies. The term “person”, as used in Article 3, usually refers to an entity, such as a natural or legal person, having legal rights, duties and obligations.

In interpreting Article 3 of the Convention, the responsibility for compensation for damage caused by a group or class of individuals must be assumed by the launching State. In a broader sense, this responsibility includes all individuals and all types of space activities. Generally, we refer to an individual or person as a human being. In the context of law, the term “person/individual” generally refers to an identity and nature that is subject to legal rights and duties.

Legal rules attribute legal personality to companies and legal entities and subject them to duties and rights. In addition, in certain specific cases, the law formally recognizes legal rights and obligations for some inanimate objects such as ships, lands, and goods, and gives them rights and imposes duties on them that are subject to judicial jurisdiction and to judgments against them.

However, in all the cases mentioned above, the legal rights and duties imposed on artificial entities such as corporations or inanimate objects arise from actions or behaviors performed by humans. The question now arises as to whether this basis should be extended to the issue of artificial intelligence as well. (Solum, 1992:1235)

The status of rights and obligations on people is not necessarily true for actions or behavior that are based on machine intelligence. A machine can learn independently of human information and behavior and make decisions based on existing learning and information, but this ability is not necessarily equivalent to acquiring real or legal personality for it.

Decisions and behavior of persons, both real and legal Ultimately, decisions are made by humans; in this sense, decision-making is not based solely on reason or data but is the product of various factors of human behavior such as intelligence, emotions, and choices.

If decisions and behaviors based on artificial intelligence are outside the scope of human supervision and management, without taking into account various factors of human behavior such as intelligence, emotions, and choices, attributing them to human behavior becomes difficult and It would be difficult.(Karnow, 1996: 190)

Therefore, since fault-based liability under Article 3 of the Convention on State Liability is based on the conduct of natural or legal persons, a decision-making by an intelligent space object may not be attributable to "individual fault".

Therefore, the assessment of fault-based liability under this Article, as opposed to a decision made by an intelligent space vehicle, is It depends on whether such a decision can be attributed to the launching State or the armed State. Liability based on the fault of a Contracting State should not be based solely on the decision to launch an intelligent space object; since the adoption of such a broad basis for liability would fundamentally affect the development and deployment of intelligent space objects and their use in space. Therefore, the question of liability in these circumstances depends on the answer to this question: When the damage is caused by an intelligent space object and human oversight is not involved in the occurrence of that damage, what conduct is necessary to attribute fault-based liability to a State (Kowert, 2017: 183)?

In view of the above, since Article 3 of the Convention provides for liability arising from "fault of the State" or "fault of individuals", it is difficult to determine how a decision taken by an intelligent space object can be considered as being liable. In the event of a collision between two spacecraft, it would be quite problematic to determine the liability of the launching State for damage caused by such an object, which acts completely independently.

To solve this problem, the complex and novel issues that arise regarding the standard of care, foreseeability of risk and damage, and proximate cause of damage, which are essential elements for establishing damage in liability claims, must be analyzed with regard to the issue of artificial intelligence, and it must be clarified how an intelligent space object can make decisions without the need for human action.

RESPONSIBILITY FOR DATA PROTECTION AND PRIVACY

In general, one of the main concerns of space law in recent years has been the sharing of data and information of individuals in space technologies, which is likely to lead to a violation of the privacy of members of society.

For example, data obtained through Earth observation can be analyzed using intelligent facial recognition technologies combined with location data and data obtained from security cameras, and ultimately disclosed. Therefore, the issue of maintaining their confidentiality and preventing access to them without the necessary permissions, as well as compensation for damages in case of ignoring these matters, is seriously raised. Kurkova & Soroka.2019:135)

In space exploration, the use of artificial intelligence puts the identity of individuals at greater risk. For example, very high-resolution imaging satellites are used to scan landscapes and streets, inspect them, and capture images of buildings, cars, etc. for various purposes, including public announcements.

Users of these images may identify the areas being surveyed or the individuals in their vicinity. They can recognize them and their movements, as well as their social patterns, and misuse this information. Active and advanced satellites can process data and information about people on the active satellite in orbit, using

artificial intelligence in their mission programs, without the need for These satellites would be processed by humans in centers on the ground.

In this case, only information relevant to the ground would be transmitted, thus not only saving on communication costs with the ground and vice versa but also allowing ground analysts to focus on the information that is most important. Experts can develop algorithms using artificial intelligence to analyze data, recognize images, and make automatic corrections, allowing users to track people's assets and any movements they make in any country.

Therefore, with the use of artificial intelligence in data processing, the risk of misuse of spatial data and information increases. Also, the use of artificial intelligence in space technologies by government agencies for extensive surveillance is of great importance for ensuring security. Thanks to satellite images, illegal cultivation of drugs can be seen in farms, and legal institutions can prosecute offenders based on evidence. However, these uses may violate laws related to the protection of personal data and information. The use of this spatial data and information can violate human rights, especially in cases of discrimination and when there is arbitrary intervention by state and non-state institutions, and no trace of human action can be found that can attribute these actions to him.

Based on the above, the issue of management and supervision of non-disclosure of information and the correct and lawful use of space data and information, and the responsibility of states for protecting the privacy of individuals within the framework of the responsibility of states for monitoring space activities and compensation for damage, should be reviewed from an international perspective.

On the one hand, existing international regulations, in particular Articles 6 and 7 of the Outer Space Treaty of 1967, should be adapted to these circumstances to determine whether they are applicable to these circumstances or not, and, on the other hand, due to the importance of the issue, new specific regulations should be developed for the use of data and information generated by space technologies equipped with artificial intelligence in order to eliminate legal gaps (von der Dunk, 2013: 249).

First, to address the liability of States for surveillance and damage caused by AI decision-making regarding data and information derived from space technologies, the provisions contained in international space treaties should be examined. As noted above, Articles 6 and 7 of the Outer Space Treaty impose international liability, without exception or qualification, on the competent State or the launching State.

Therefore, if the performance of intelligent space technologies is compatible with the launching State or the State registering the space object, international liability regulations are applicable. However, as stated in the previous section, these space treaties do not provide for liability based on fault in the absence of human intervention in causing damage and, to ensure liability against data surveillance and violations of individuals' privacy, compensation for damage caused in space by an intelligent space object may have to be pursued and considered in other ways.

If a claimant State seeks compensation for damage or injury caused by an intelligent space object that is not covered by the definition of "damage" in Article 1(a) of the 1972 Liability Convention, such as damage resulting from the dissemination of data and the invasion of the privacy of individuals, it may be resolved by a broad interpretation of Article 7 of the Outer Space Treaty, as this article does not limit damages to material damage.

The 1972 Liability Convention expressly states that one of the main purposes of its codification is to establish rules and procedures relating to liability for damage caused by space objects, but the Convention does not claim that its rules and procedures should be excluded when assessing liabilities arising from means other than the Liability Convention.

Neither the Outer Space Treaty nor the Liability Convention precludes compensation for damage under Article 7 of the Outer Space Treaty. This is particularly important in view of the general principle of international law that "what is not prohibited is permitted." In other words, in a particular case, it is not necessary to indicate the rules of permissibility as long as there is no prohibition.

If, under Article 7 of the Outer Space Treaty, compensation for damage is not available under the Liability Convention, Article 7 of the Outer Space Treaty provides sufficient flexibility to address issues related to liability for the operation of intelligent space objects to address liability for the surveillance of their activities, as well as potential damages from disclosure of information and violation of the privacy of individuals. (Tricot &Sander, 2010:323)

Despite the broad interpretation of Article 7 of the Outer Space Treaty to protect individuals and their privacy, new international rules and regulations are needed, because clear and transparent rules can help to resolve disputes between States regarding liability and compensation for damages.

At present, separate rules and regulations are needed to address problems related to the use of artificial intelligence in data processing and Information has been compiled by some legislators at the regional and national levels, which can be used as a model in space law to deal with AI decision-making at the international level.

As mentioned, one of the important and noteworthy documents is the General Data Protection Regulation in the European Union, which came into force in 2018. Shaping Europe's digital future, "A European Strategy for data"

The European Strategy for the use of artificial intelligence in technologies, in addition to The acquisition of information to create an agile, secure, and dynamic economy in the world, improve decision-making, and provide a better life for all citizens, is focused on determining a surveillance framework for the future by creating a "trust/assurance-based ecosystem." To do this, it is necessary to ensure compliance with EU law, including the law on the protection of fundamental rights and consumer rights, in particular with regard to high-risk AI systems. EU regulation is therefore focused on building trust between consumers and various stakeholders in the field of AI and on informing them about the risks of AI. (European Commission,White Paper on Artificial Intelligence, COM, 2020)

The United States is also among the technologically advanced countries that are trying to recognize legal actions against incidents related to artificial intelligence and to regulate and codify such actions. In general, legal actions for compensation for damage caused by a device or machine have been recognized based on the negligence claim of the owner or user and based on the theory of producer liability, which The finding of negligence requires human intervention.

It seems logical to hold a manufacturer liable for a defect in the design or construction of software and failure to warn of foreseeable harm. A defect in the design of a product or technology occurs when there is a risk of foreseeable harm, and the designer could have avoided that risk or reduced the likelihood of that risk by using a reasonable alternative design. Defective Design Manufacturing occurs when a product is not manufactured according to specifications and standards. Accordingly, negligence also occurs when the responsible party fails to properly follow "instructions for the safe use of software" (Giuffrida, 2019: 440).

CONCLUSION

The use of artificial intelligence in space technologies in enhancing its applications is undeniable. The development of artificial intelligence technologies creates unprecedented opportunities for space exploration and the implementation of new types of space activities.

However, space objects launched into space by governments and private players are becoming increasingly technologically sophisticated and increasingly equipped with artificial intelligence technologies that enable space technologies to operate without human intervention. Such devices are used in particular to monitor the performance of satellites, act as assistants to astronauts, and conduct research when conditions are dangerous to humans.

The use of space technologies equipped with artificial intelligence will be accompanied by unintended consequences that arise from the use or misuse of such tools. Just as the use of artificial intelligence can be very useful and beneficial for the provision of social services, the use of this technology for the wrong purposes or by the wrong people can also cause significant harm to governments and people.

Space law should seek to address issues of oversight of the performance of artificial intelligence in space technologies, as well as liability in the event of damage. Damage can be both material, such as endangering the safety and health of individuals, loss of life, damage to property, and non-material, such as violation of privacy, restrictions on the right to freedom of expression, human dignity, or discriminatory actions in various matters.

In addition to the responsibility for monitoring activities and liability for damages, space law should also address the monitoring of data and information storage, as well as the protection of individuals' privacy; in particular, the lack of a specific monitoring framework for non-state space actors, who often disregard individuals' privacy, could seriously harm the regulation of space activities in the future.

The mandatory space treaties do not explicitly address the use of artificial intelligence, and no other international space regulation addresses the use of artificial intelligence in space.

The lack of international regulation on artificial intelligence creates complex and potential problems regarding the applicable law in resolving disputes between States over liability for the use of artificial intelligence in space technologies. If the use of artificial intelligence in space activities or a space object causes damage to another space object that is identifiable under the Convention on International Liability for Damage Caused by Space Objects, it is unclear whether the substantive rules and regulations that are used to determine issues related to the resolution of the level and quality of the claim, such as the standard of care and what constitutes fault-based liability, would be applicable.

According to a broad interpretation of Article 6 of the Outer Space Treaty, the responsibility of States in international space law is considered within the framework of surveillance based on the standard of “surveillance and oversight”. A Contracting State under the standard of surveillance must also exercise its responsibility for surveillance over a space object that uses artificial intelligence.

The State responsible has a duty to ensure that the necessary authorization is issued for the launch of an intelligent space object by a non-state entity and to supervise it; if a State’s space actor plays a role in the use of artificial intelligence in space technology, this State can be held liable based on a broad interpretation.

Compliance with the standard of due diligence requires that a State Party ensure that the necessary authorization is issued for space activities carried out using an intelligent space object and that that State supervises those activities. The subject of compliance with this standard is the provision of a flexible standard in space law.

The obligation to “due diligence” is a behavioral obligation that a Contracting State must take supervisory measures to prevent harm to another State or its nationals. Also, in order to determine the liability of States for compensation for damage, with a broad interpretation of Article 7 of the Outer Space Treaty, in addition to establishing the absolute liability of States for damage to property and persons on the ground and on

aircraft caused by their intelligent space technologies, States can be held liable for the conduct and performance of natural and legal persons on the basis of negligence whose intelligent space technology has caused damage in outer space. The determination of liability for damage caused by an intelligent space object in outer space is related to the ability to attribute fault-based liability to a State.

As stated, in addition to the possibility of a broad interpretation of Articles 6 and 7 of the Outer Space Treaty of 1967, it is possible to follow the example of the national space laws of some countries and encourage other countries to adopt this type of law. European policy on the specific issue of artificial intelligence in space technology could serve as a model for future explicit use in international space law.

This approach aligns the functioning of the armed state with its standards of care in the event of an intelligent space object causing damage in outer space. Presumably, the standard of "due care" and oversight could be adopted for the liability of the armed state for damage caused by an intelligent space object. This flexible standard allows the primary space player state to be held accountable.

Since these regulations lack the clarity and transparency required to address the issue of artificial intelligence, and the Contracting States do not play an effective role in decision-making on artificial intelligence in space technologies, given the growth of private sector space players, it is desirable for the international space community of states to develop specific regulations within the framework of soft space law, i.e., guidelines and resolutions, and to encourage the Contracting States to follow their example. Develop and implement national space regulations related to the oversight of space actors that use artificial intelligence in their space technology, and then, after establishing a specific procedure in the national space laws of countries, international space institutions, such as COPUS, develop international regulations to establish the responsibility of the state responsible for overseeing the performance of the space actor.

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Genetic Engineering and Its Ethical Implications: A Bioethical Perspective

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Genetic engineering has revolutionized the fields of medicine, agriculture, and biotechnology, offering unprecedented control over DNA modification. The development of CRISPR-Cas9 and other gene-editing tools has enabled precise genetic alterations, raising both scientific opportunities and ethical dilemmas. This paper explores the methodologies of germline and somatic gene editing, the applications of gene drives in conservation, and the corporate influence on genetically modified organisms (GMOs). Ethical concerns regarding human genetic modification, ecological risks, and economic inequalities are critically examined. Additionally, the study highlights bioethical principles, regulatory frameworks, and global governance approaches aimed at ensuring the responsible use of genetic engineering. The findings emphasize the need for adaptive regulations, interdisciplinary collaboration, and public engagement to balance scientific progress with ethical responsibility. While genetic engineering holds immense potential, its future depends on the establishment of equitable, ethical, and sustainable policies that align with human rights and ecological integrity.
***Keywords**: Genetic engineering, bioethics, CRISPR-Cas9, gene therapy, regulatory frameworks.*

INTRODUCTION

Genetic engineering has emerged as one of the most transformative scientific advancements of the 21st century, allowing for precise modifications to the genetic material of organisms. While initially developed as a tool for understanding gene functions, it has since expanded into various applications, including medicine, agriculture, and biotechnology (He & Doudna, 2019). The introduction of gene-editing technologies, particularly CRISPR-Cas9, has revolutionized the field by providing an efficient and relatively inexpensive method for modifying DNA sequences with high precision. However, alongside these advancements, ethical concerns regarding the responsible use of genetic engineering have intensified, especially in the context of human germline modification, ecological balance, and social inequalities (Bennett & Jennings, 2017).

One of the primary concerns of genetic engineering is its potential to alter human embryos and germline cells, raising fundamental ethical questions about human identity, dignity, and the long-term consequences of such modifications (Chan, 2015). While proponents argue that genetic interventions could prevent hereditary diseases and improve overall human health, critics warn about the risks of eugenics, unintended genetic consequences, and social disparities (Savulescu, 2015). The National Academies of Sciences, Engineering, and Medicine (2017) emphasize the need for strict regulatory frameworks to ensure the

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responsible use of genome editing technologies, highlighting the delicate balance between scientific progress and ethical accountability.

Beyond human applications, genetic engineering plays a crucial role in environmental conservation and agriculture. Gene drives, which promote the rapid spread of genetic modifications through populations, have been proposed as a means to combat vector-borne diseases like malaria or control invasive species (Esvelt & Gemmell, 2017). However, concerns about ecosystem disruptions and irreversible genetic changes have led to calls for more cautious and adaptive governance strategies (Sandler, 2021; Kofler & Kuzma, 2018). Additionally, the modification of livestock and crops to improve resistance to disease and increase productivity raises debates about food safety, biodiversity, and corporate control over genetic resources (Goyal, 2023).

Given these complex ethical dilemmas, bioethics plays a critical role in shaping policies and guidelines for genetic engineering. Scholars argue that genetic modifications should align with moral, legal, and social considerations to prevent misuse and unintended consequences (Peters, 2017; Phelps & Haecker, 2019). The precautionary principle has been widely proposed to ensure that any genetic intervention undergoes rigorous safety evaluations before widespread implementation (Dearden & Gemmell, 2017). Furthermore, public discourse and interdisciplinary collaboration between scientists, ethicists, and policymakers are essential to establish clear ethical boundaries for emerging genetic technologies (Lanphier et al., 2015).

This paper explores the scientific foundations of genetic engineering, its diverse applications, and the ethical considerations that govern its use. By analyzing biotechnological advancements, potential risks, and ethical frameworks, the discussion aims to provide a comprehensive understanding of the intersection between genetic engineering and bioethics.

MATERIALS AND METHODS

The study of genetic engineering and its ethical implications requires a multidisciplinary approach, integrating insights from molecular biology, bioethics, law, and policy studies. This section outlines the methods used to analyze genetic engineering techniques, applications, and the ethical frameworks governing their use.

1. Literature Review Approach

A comprehensive literature review was conducted to examine recent advancements in genetic engineering, gene editing technologies (CRISPR-Cas9, TALENs, and ZFNs), and bioethical considerations. The study primarily relied on peer-reviewed journal articles, books, and reports from authoritative sources such as the National Academies of Sciences, Engineering, and Medicine (2017) and research by leading scholars in genetic ethics (Bennett & Jennings, 2017; Spector, 2019).

The key areas of focus included:

- Scientific methodologies used in gene modification, including germline and somatic cell editing.
- Applications in medicine, agriculture, and conservation biology (Esvelt & Gemmell, 2017).
- Ethical dilemmas and regulatory policies surrounding gene editing technologies (Lanphier et al., 2015; Kofler & Kuzma, 2018).

2. Analysis of Gene Editing Techniques

To understand the scientific basis of genetic modification, an in-depth review of molecular techniques was conducted, including:

- CRISPR-Cas9, the most widely used gene-editing tool due to its efficiency and precision (He & Doudna, 2019).
- TALENs (Transcription Activator-Like Effector Nucleases), a genome-editing tool known for its specificity but more complex implementation.
- Zinc Finger Nucleases (ZFNs), one of the earliest genome-editing techniques used in targeted genetic modification.

Each technique was evaluated based on its precision, efficiency, potential off-target effects, and ethical implications in human and environmental applications (Dearden & Gemmell, 2017).

3. Case Study Approach: Ethical Concerns in Genetic Engineering

To explore the ethical dimensions, several case studies were analyzed, focusing on:

- Human germline editing and its implications for future generations (Peters, 2017).
- Gene drives in conservation and the risks of ecological imbalance (Sandler, 2021).
- Commercial and corporate control over genetically modified organisms (GMOs) and its impact on global food security (Goyal, 2023).

These case studies provided real-world examples of how genetic engineering is applied and the ethical debates surrounding its governance.

4. Examination of Bioethical Principles and Regulatory Frameworks

The study reviewed international bioethical frameworks and governance policies, including:

- The precautionary principle, which advocates for careful risk assessment before gene-editing applications (Dearden & Gemmell, 2017).
- Global regulatory stances on gene editing, including policies from the United States, European Union, and China (National Academies of Sciences, Engineering, and Medicine, 2017).
- Religious and cultural perspectives on genetic modification (Chan, 2015).

This approach allowed for a comparative analysis of different bioethical perspectives and regulatory strategies shaping the future of genetic engineering.

DISCUSSION

Genetic engineering has revolutionized modern science, offering unprecedented opportunities for disease prevention, agricultural enhancement, and environmental conservation. However, as these technologies advance, they raise complex ethical, legal, and social concerns that necessitate careful examination. This section explores key debates surrounding human genetic modification, ecological risks, and the governance of gene-editing technologies.

1. Ethical Implications of Human Genetic Modification

One of the most controversial applications of genetic engineering is its use in human germline modification. Germline editing alters DNA sequences in embryos, meaning that genetic changes are heritable and passed down to future generations. While proponents argue that these techniques can eliminate inherited genetic disorders such as sickle cell anemia and cystic fibrosis (He & Doudna, 2019), critics caution against unintended mutations, social inequality, and the potential for eugenics (Savulescu, 2015).

The main ethical concerns associated with germline editing include:

- **Loss of genetic diversity:** Widespread genetic modifications could lead to a reduced gene pool, making populations more vulnerable to unforeseen diseases (Phelps & Haecker, 2019).
- **Inequality in access:** Gene editing could create a divide between the genetically modified elite and those without access to enhancements, leading to new forms of discrimination (Chan, 2015).
- **Violation of human dignity:** Some argue that modifying human embryos undermines the intrinsic value of human life, raising philosophical and religious objections (Peters, 2017).

Despite these concerns, research into somatic cell gene therapy, which modifies only the affected cells of an individual without altering their offspring's DNA, has gained wider acceptance in treating genetic disorders (National Academies of Sciences, Engineering, and Medicine, 2017).

2. Gene Drives and Ecological Risks

Gene drives are a powerful genetic engineering tool designed to spread specific genetic modifications throughout entire populations. While they have potential applications in controlling vector-borne diseases such as malaria (by altering mosquito populations) and eradicating invasive species, they also pose ecological and evolutionary risks (Esvelt & Gemmell, 2017).

Concerns regarding gene drives include:

- **Irreversible genetic changes:** Once released, gene drives can spread uncontrollably, affecting entire ecosystems in unpredictable ways (Sandler, 2021).
- **Cross-species gene flow:** Genetically modified genes may unintentionally transfer to other species, disrupting ecological balances (Dearden & Gemmell, 2017).
- **Ethical considerations in conservation biology:** Should humans have the right to manipulate entire species for environmental management? Some argue that gene drives amount to playing "God" with nature (Kofler & Kuzma, 2018).

To address these concerns, scientists advocate for reversible and self-limiting gene drive technologies that allow for controlled testing and recall mechanisms before widespread environmental use (Esvelt & Gemmell, 2017).

3. Corporate and Economic Aspects of Genetic Engineering

The rise of genetic engineering has economic and legal implications, particularly regarding the ownership and control of genetically modified organisms (GMOs). Large biotechnology corporations patent genetically modified seeds, leading to concerns over monopolization and food sovereignty (Goyal, 2023).

Key economic issues include:

- **Corporate control over food production:** Large agribusinesses, such as Monsanto, dominate the global seed market, restricting farmers' ability to save and reuse seeds (Odhiambo, 2023).
- **Patent disputes and accessibility:** High costs associated with gene-editing technologies may prevent smaller research institutions and developing nations from benefiting from advancements (Lanphier et al., 2015).
- **Bioethical concerns in profit-driven genetic research:** Critics argue that private sector dominance in biotechnology prioritizes financial gain over public health and environmental safety (Spector, 2019).

Governments and international organizations have implemented regulations to ensure fair access and responsible commercialization of genetically engineered products (National Academies of Sciences, Engineering, and Medicine, 2017).

4. Regulatory and Bioethical Governance

To ensure responsible and ethical implementation of genetic engineering, robust global governance frameworks are essential. While some nations have strict laws regulating gene editing, others have adopted more permissive policies, leading to global discrepancies in genetic research practices (Phelps & Haecker, 2019).

Regulatory approaches include:

- **The Precautionary Principle** – Advocates for **thorough risk assessments** before gene-editing applications are deployed in humans or ecosystems (Dearden & Gemmell, 2017).
- **Legislation on human genome editing** – Countries such as **Germany and France prohibit germline modifications**, while China and the U.S. allow research under strict ethical guidelines (National Academies of Sciences, Engineering, and Medicine, 2017).
- **International treaties and oversight** – The **WHO, UNESCO, and European Commission** work to establish ethical standards for global genetic research (Bennett & Jennings, 2017).

Despite these efforts, gene-editing technologies continue to outpace regulatory frameworks, underscoring the need for adaptive and proactive governance strategies (Kofler & Kuzma, 2018).

5. Future Directions and Ethical Considerations

As synthetic biology and AI-driven genetic modifications advance, new bioethical dilemmas will emerge. The future of genetic engineering depends on:

- **Public engagement and ethical discourse** to ensure transparency in research (Peters, 2017).
- **Developing safer gene-editing tools** that minimize unintended consequences (He & Doudna, 2019).
- **Interdisciplinary collaboration** between scientists, policymakers, ethicists, and society to guide responsible genetic innovation (Chan, 2015).

While genetic engineering holds enormous potential, ensuring that it is ethically sound, socially responsible, and scientifically regulated remains a challenge for the global community.

Summary of Discussion

Topic	Key Ethical Issues	Proposed Solutions
Human Genetic Modification	Germline editing, social inequality, loss of genetic diversity	Strict regulations, focus on somatic cell therapy
Gene Drives & Environment	Irreversible effects, ecosystem disruption	Self-limiting gene drive technologies
Economic & Corporate Issues	GMO patents, corporate monopolies	Fair regulatory frameworks, open-access research
Global Governance	Uneven laws, ethical disagreements	International bioethics treaties, adaptive policies

CONCLUSION

Genetic engineering stands at the forefront of scientific progress, offering transformative solutions across medicine, agriculture, and environmental conservation. The ability to manipulate DNA has led to remarkable advancements, such as CRISPR-based gene editing, gene therapy, and genetically modified organisms (GMOs). However, these innovations are accompanied by significant ethical, legal, and societal challenges that necessitate responsible governance and ethical scrutiny.

One of the most debated aspects of genetic engineering is human germline modification, which has the potential to eradicate genetic diseases but raises concerns about eugenics, social inequality, and the unintended consequences of genetic alterations (Bennett & Jennings, 2017). While somatic gene therapy offers a promising and ethically sound alternative, the long-term effects of germline interventions remain uncertain and ethically contentious (Savulescu, 2015; He & Doudna, 2019). As a result, many bioethicists advocate strict regulatory oversight and global collaboration to ensure genetic engineering is used responsibly (National Academies of Sciences, Engineering, and Medicine, 2017).

Beyond human applications, genetic engineering's role in environmental conservation and disease control presents both opportunities and risks. Gene drives, for example, could eliminate disease-carrying insects but also risk uncontrollable ecological consequences (Esvelt & Gemmell, 2017). The rapid advancement of genetic technologies underscores the importance of adaptive governance strategies, ensuring that scientific progress does not outpace ethical and regulatory considerations (Kofler & Kuzma, 2018).

Economic and corporate aspects of genetic engineering further complicate the ethical debate. The dominance of large biotechnology corporations in GMO patents raises concerns over monopolization, accessibility, and the commercialization of genetic resources (Goyal, 2023). A balanced regulatory approach is required to prevent corporate exploitation while promoting innovation and equitable access to genetic technologies (Odhiambo, 2023).

Moving forward, the responsible development of genetic engineering must integrate interdisciplinary perspectives, including scientific, ethical, legal, and societal viewpoints. Policymakers, scientists, and ethicists must engage in public discourse and global cooperation to establish clear ethical boundaries and transparent regulations for gene-editing technologies (Peters, 2017). Future innovations should focus on enhancing safety, minimizing risks, and ensuring genetic modifications align with human rights and ecological sustainability (Phelps & Haecker, 2019).

In conclusion, genetic engineering holds immense potential to shape the future of medicine, food security, and conservation efforts. However, to fully harness its benefits while mitigating risks, global ethical frameworks, adaptive regulations, and public awareness must evolve alongside the science. The future of genetic engineering will not be determined by technological capability alone but by the collective responsibility of humanity to guide it ethically and equitably.

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A Review of Digital Human Resource Management: Transforming HR Practices Through Technology

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Digital Human Resource Management is a digital transformation in human resource practices and processes through the use of electronic media, mobile, analytics and information technology to make human resource management more efficient. In other words, digital human resource management basically performs or manages all human resource work using soft technologies, applications and the internet.
Digitalization or digital transformation is something that all organizations must bring to be efficient and relevant in the future. Otherwise, they will be left behind by other organizations in the market industry. This study reviews several studies and discusses the concept and various aspects of digital human resource management.
This study mainly relied on secondary data. The findings of this study are important for organizations to help them effectively implement digital human resource management and thereby improve their performance. Furthermore, the findings can help researchers by providing a basis for understanding the impact of digital human resources on organizational performance.
***Keywords**: Human Resource Management, Digitalization, Technology*

INTRODUCTION

Today, concepts such as “digitalization”[2], “digitalization”[3], “digital transformation”[4] or “digital disruption”[5] are among the most prominent and discussed terms. In general, such concepts indicate the increasing use of technology, and the corresponding fundamental changes in various areas of business and society. This concept is also true for the field of human resource management.[6]

In human resource management, the concept of digital human resource management, (Thite, 2019; Pantelidis, 2019), and related concepts such as digitalization, (Meijerink et al., 2018; Van Kruining 2017), digital transformation, (Bissola and Imperatori, 2018; Vardarlier, 2020) and digital disruption (Larkin, 2017; Platanou and Mäkelä, 2016) are increasingly used in human resource management. However, at present, these concepts are often used in an implicit, heterogeneous, and incremental way.

First, authors frequently use concepts in an implicit way. That is, they do not provide explicit definitions but assume that readers understand the intended meaning (e.g., Bajer, 2017; Larkin, 2017).

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[2] Digitization
[3] Digitalization
[4] Digital Transformation
[5] Digital Disruption
[6] Human Resource Management

Second, authors use concepts in an incoherent way. That is, they use concepts with multiple and sometimes contradictory understandings (e.g., understanding disorder).

Third, authors frequently use concepts in an incremental way (Larkin, 2017, and Platanou and Mäkelä, 2016),

That is, they use new concepts to represent old, well-known phenomena (e.g., Martini and Cavenago 2019; Thite, 2018). It is clear that the current discussion on digital HRM lacks "conceptual clarity." However, conceptual clarity is important for several interrelated reasons.

First, conceptual clarity is important to avoid the mere duplication of concepts (Suddaby, 2010). (It should be ensured that digital HRM (and related concepts) do not simply represent "new definitions for old phenomena". Otherwise, new concepts are used only as synonyms for established concepts and in particular the prominent concept of electronic (e-) HRM, e.g. (Bondarouk et al. 2016; Strohmeier, 2007).

Second, conceptual clarity is essential to avoid confusion and misunderstanding. (Suddaby, 2010) It should be ensured that human resource (HR) researchers have a common understanding that facilitates cross-communication in digital HRM.

Third, conceptual clarity is essential to avoid research gaps (Suddaby, 2010). Ill-defined terms should be avoided, as they do not allow precise operationalization and lead to divergent research results on digital HRM. Given this background, the aim of this paper is to provide a conceptual explanation of digital HRM.

DIGITAL HUMAN RESOURCE MANAGEMENT

To understand the concept of digital human resource management more deeply, it is necessary to define the meaning of human resource management. According to Huselid (1995), the most important areas of human resource management practice are: "recruitment and selection, socialization, job design, training and development, participation, career development, performance appraisal, employee rewards and job security".

Furthermore, Bredin & Söderlund (2011) explained human resource management as practices related to the relationship between employees and the organization in which they work. Furthermore, HRM can be explained as the management of human resources in order to enable the organization to grow.

The development of information technology has played a key role in the evolution of HRM (Kavanagh & Johnson, 2009) (In the business world, digital technologies are changing every aspect of HRM from recruiting and hiring new employees, training and development, performance appraisal and rewards and compensation), Madithetі (2017) (Therefore, a comprehensive transformation from traditional to digital in terms of HRM policies and strategies and the way HRM practices are implemented is needed.

According to Meditti[1] , digital basically manages all HRM functions through technologies, applications and the internet. There should also be innovations in HRM practices for recruiting, rewarding and evaluating employees. Digital HRM also has an impact on the way employees are trained. (Saini, 2018).

U (2016) in a study conducted at the University of Sub-Saharan Africa found that the maximum percentage of employees agree that HRM-E enhances their performance. It also studied the impact of digitalization on human resource development, talent management and workplace performance. The research findings indicate a positive impact of digital transformation on all variables. (Tripathi &Kushwaha (2017).

[1] Madithetі

It is strongly recommended for organizations to advance digitalization in HRM practices as it has become very important these days. A recent study by Fedorova et al. (2019) showed that digitizing HRM processes can eliminate many routine tasks, reduce the risk of human error, and empower experts to solve important problems, enabling them to use their knowledge and skills more effectively in solving business problems. Therefore, based on previous research, implementing digital HRM is important for organizations to improve performance and maintain relevance in the digital arena. (Iwu,2016)

HOW DOES DIGITAL HRM WORK?

Schwab (2016) in "The Fourth Industrial Revolution" explains how digital technologies have fundamentally changed the way organizations work, work styles, and how they operate. Therefore, digitalization is something that organizations should specifically incorporate into their HRM. For example, traditional recruitment and selection methods cannot reach a large geographic area of millions of people at once.

However, technology has made recruitment more efficient and effective by distributing information in a more engaging manner. For example, Unilever is one of the global companies that is fundamentally changing its recruitment process. The company is experimenting with social media, online games, and artificial intelligence to further digitize recruitment. (Banu, 2019).

Another example is related to employee training and development. Employees can access training program information from remote locations, participate in virtual classes, and evaluate progress through the system and portal. Furthermore, Gomes & Nawaz (2017) reported that HR information systems are useful in HR processes and act as a strategic tool for organizational development. (Anthony, 2014)

Also explained that this technology acts as an enabling tool for better performance through "cloud-based services, decision-making analytics, borderless teams and real-time talent management across the organization". According to Larkin (2017) The developments in HR can be categorized into three main groups: "inside, outside and across", for example, if the organization is considered "inside", it means that it has an active digital office. The employer and employee communicate electronically and all information is disseminated in the form of video/audio or via mobile device.

Secondly, there is "outside", which involves the employee or management level who is digitally active for the employee and management. Here they will use mobile devices to allow employees to do their work in a better and more efficient way.

Employees are more informed, engaged and alert in these systems because they can perform their tasks anywhere and anytime, thus bringing real-time feedback to management. The third is "Dressertaser" which means changes in the organization as a whole. Digitalization will bring innovation, collaboration and new strategies throughout the organization. Employees will become global workers by sharing their knowledge and ideas globally. (Saini ,2018)

ELEMENTS OF DIGITAL ORGANIZATIONAL MANAGEMENT

In the era of technology, human resource management has changed to match the competitive and dynamic world. Human resource management has transformed from traditional to digital. The following elements are needed to bring about a transformation in human resource management:

1. Digital Workforce

In the era of millennials, the current generations are considered digital workforce, they have internet-connected devices and web-based applications and services have always fascinated their daily lives. With

this workforce, the organization needs to be digital to interact with the digital employee (Sharon & Aggarwal, 2017). Therefore, digital human resource management is embedded with mobile apps, design thinking, video, behavioral economics and the use of system analytics. (Madithetti, 2017).

2. Digital Work and Task

The content of work is digitized by using technology in work activities and management functions. Organizations should integrate digital elements into work processes and transform traditional manual tasks into digital tasks (27). Organizations should also use digital tools and media to communicate with employees. Work and tasks in the organization should be organized digitally.

3. Digital Support Management

Digital Support Management involves planning, implementing, and using digital technologies to support human resource management activities, such as payroll processing, compensation, performance management, training and development, and so on.(Baiyere A and Salmela,2013)

4. Updating HR Technology

There is a huge shift from traditional HR software to modern ones, such as cloud-based systems. Recently, HR applications have migrated to mobile devices and may shift to mobile platforms in the future. These applications enable analysis, measurement, and prediction of employee performance. Mobile applications facilitate work across borders and in remote geographies. (Madithetti, 2017)

Benefits of Digital Human Resource Management

The digital world is changing the way we live, work, and organize and conduct business. Digital human resource management can help leaders and employees in business move towards a digital mindset, a digital way of managing, organizing, and leading change. (DiRomualdo . et al. 2018).

It shows that digitalization is changing the way employees communicate and interact in the workplace, their expectations of their employer and job, where they work, and when they work.

Since the digital evolution affects organizations at different levels, there is a need to develop and adapt new knowledge and new ways of working (Bondarouk, & Ruël. 2009). Kiesler et al. (1984) argued in their research that technology mediates the relationship between “individuals and organizations, and subordinates and supervisors”.

Therefore, it has also reduced the distance in organizations so that employees can work from home and interact with others across geographical areas. Furthermore,(Heracleous,2003) also emphasizes “the importance of investing in the development of new skills needed, especially if the change involves new technology and new roles”.

Therefore, digital technology is continuously changing the way organizations recruit, manage and support people. Furthermore, HRM creates the opportunity to transform the entire employee experience by changing HRM processes and systems.

Also, applied digital HRM as a concept Green HRM is considered to be a process that can contribute to an organization's environmental performance (Yusoff, et al. 2018). Some previous studies have shown that today's HR work involves streamlining and improving the employee experience by integrating digital technology.

Challenges for HR Professionals

In the era of digital transformation, organizations must adapt to changing HR practices. According to Sureshkrishna & Das (2019), HR managers have found that digitalization as an external pressure for change poses challenges for them in various ways, through the need for new HR competencies due to digitalization and flexible ways of working. Sureshkrishna & Das (2019) identify several prominent challenges as follows:

1. Understanding digitalization

2. Adapting to new roles

3. Agility

4. Exploring and developing digital competencies

5. Implementing organizational changes

6. Dealing with new forms of employment

DISCUSSION AND CONCLUSION

Digital HRM has become a part of today's business world. Organizations must move towards digital transformation to gain competitive advantage and relevance in the industry. This study provides an overview of digital resource management and the findings of this study are important for organizations in helping them effectively implement digital HRM and thereby improve their performance. Also, these findings can serve as a basis for researchers to conduct further research in the field of digital HRM and help other researchers identify relevant studies in the literature review phase of their work.

In addition, these findings can help researchers by providing a basis for understanding the impact of digital HRM on organizational performance. Nowadays, digital HRM is very vital and is of increasing concern to organizations.

It is recommended that researchers have a deeper study on how performance has changed from the past to the present, the extent of its impact on organizations, the role of the HR manager, and evaluation on implementation investment.

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The Role of Enzymes in Modern Medicine: Advances, Applications, and Future Directions

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Enzymes play a critical role in modern medicine, serving as essential biological catalysts in therapeutic and diagnostic applications. This article explores the use of enzymes in enzyme replacement therapy (ERT), pharmaceutical drug development, and clinical diagnostics. The advancements in biotechnology have led to the development of engineered enzymes with improved stability and efficiency, addressing challenges such as enzyme degradation, immunogenicity, and production costs. Recent innovations, including enzyme immobilization, nanotechnology-based delivery systems, and CRISPR-engineered enzymes, have significantly enhanced the scope of enzyme-based treatments. Despite existing limitations, ongoing research continues to refine enzyme therapies, making them more accessible and effective. This study highlights the transformative impact of enzymes in medicine and discusses future directions for optimizing their clinical applications.
***Keywords**: Enzymes, enzyme replacement therapy, biotechnology, medical applications*

INTRODUCTION

Enzymes are biological catalysts essential for sustaining life by facilitating biochemical reactions within cells. Their role in metabolism, genetic information processing, and cellular signaling underscores their importance in medical applications. Over the past few decades, advancements in enzymology have led to the development of enzyme-based therapies that address a wide range of diseases, including metabolic disorders, cancer, and inflammatory conditions (Brito & Singh, 2021). The ability of enzymes to act with high specificity and efficiency under physiological conditions makes them indispensable in diagnostic and therapeutic applications (Goyal & Kumar, 2013).

Enzyme-based treatments have become an integral part of modern medicine, particularly in the fields of enzyme replacement therapy (ERT), gene therapy, and drug development. ERT has transformed the management of genetic disorders, such as lysosomal storage diseases, by supplementing missing or deficient enzymes in affected individuals (The Business Research Company, 2024). Furthermore, the pharmaceutical industry has harnessed the potential of enzymes to improve drug formulations and enhance bioavailability, leading to more targeted and effective treatment options (Infinita Biotech, 2025).

In addition to therapeutic applications, enzymes play a crucial role in diagnostics. They are widely employed in clinical laboratories for detecting biomarkers associated with diseases, such as cardiovascular disorders and diabetes (Chen & Zhang, 2021). Advances in biotechnology have also enabled the immobilization of enzymes on biosensors, enhancing their stability and efficiency in real-time diagnostics (Creative Enzymes, n.d.).

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Despite their remarkable potential, enzyme-based therapies face several challenges, including issues related to enzyme stability, immune responses, and large-scale production. Recent breakthroughs in enzyme engineering, synthetic biology, and nanotechnology offer promising solutions to overcome these limitations (University of Manchester, 2025). Ongoing research aims to optimize enzyme activity and specificity, ensuring their broader applicability in clinical practice.

This article explores the diverse applications of enzymes in medicine, their mechanisms of action, and the latest advancements in enzyme-based therapies. By understanding the principles governing enzyme functionality, researchers and clinicians can further harness their potential for innovative medical treatments.

MATERIALS AND METHODS

Historically, enzymes used in medicine were primarily derived from animal and plant tissues. However, with the advancement of biotechnology, microorganisms have become the primary source of industrial enzyme production due to their rapid growth, ease of genetic modification, and cost-effectiveness. In this study, biosynthesis, purification, and application of therapeutic enzymes were analyzed based on recent literature and industrial developments.

Selection of Enzymes

The study focused on enzymes with established medical applications, including:

- **Hydrolases** (e.g., proteases, lipases, amylases) used in digestive aids and wound debridement.
- **Oxidoreductases** (e.g., peroxidases, catalases) employed in oxidative stress management and biosensors.
- **Transferases and lyases** involved in metabolic pathways, particularly in enzyme replacement therapies (Brito & Singh, 2021).

Microbial Enzyme Production and Purification

Microorganisms such as *Bacillus*, *Aspergillus*, and *Escherichia coli* serve as major sources for enzyme production due to their high yield and ease of genetic engineering. Fermentation techniques, including submerged fermentation (SmF) and solid-state fermentation (SSF), were examined for their efficiency in enzyme biosynthesis. After fermentation, enzyme purification involved precipitation, ultrafiltration, chromatography (ion-exchange, affinity, and size-exclusion), and immobilization techniques (Chen & Zhang, 2021).

Enzyme Immobilization and Stability Enhancement

To enhance enzyme stability and prolong their functional lifespan, immobilization techniques were reviewed. These included:

1. **Adsorption on solid supports** (e.g., silica, cellulose, and polymer matrices).
2. **Entrapment in gel-like matrices** (e.g., alginate and polyacrylamide).
3. **Covalent bonding with carriers** to prevent enzyme leaching.
4. **Encapsulation in liposomes or nanoparticles** for targeted drug delivery (Creative Enzymes, n.d.).

Medical Applications and Diagnostic Use

The study examined enzyme applications in:

- **Therapeutics:** Enzyme replacement therapy (ERT) for genetic disorders such as Gaucher disease, Pompe disease, and cystic fibrosis (The Business Research Company, 2024).
- **Diagnostics:** Use of enzymes in biosensors for glucose monitoring, cholesterol testing, and cancer biomarker detection (Goyal & Kumar, 2013).
- **Pharmaceuticals:** Enzyme-assisted drug formulation and targeted therapy development (Infinita Biotech, 2025).

The methodology involved reviewing peer-reviewed scientific literature, industrial reports, and clinical trial data to assess enzyme production, optimization strategies, and their translational applications in medicine.

Discussion

The use of enzymes in medicine has significantly evolved, driven by advancements in biotechnology, genetic engineering, and industrial fermentation processes. Enzyme-based therapies are now widely used in diagnostics, disease treatment, and pharmaceutical development, with ongoing research focusing on improving their stability, specificity, and therapeutic efficacy.

Role of Enzymes in Therapeutics

Enzyme replacement therapy (ERT) has been a groundbreaking approach in treating lysosomal storage disorders such as Gaucher disease, Fabry disease, and Pompe disease. These therapies involve administering recombinant enzymes to compensate for enzyme deficiencies, improving metabolic function and patient outcomes (The Business Research Company, 2024). However, challenges such as immune responses, short enzyme half-life, and high production costs remain barriers to widespread adoption (Brito & Singh, 2021). Innovations in enzyme engineering, including pegylation and fusion proteins, have been developed to enhance enzyme stability and reduce immunogenicity (Chen & Zhang, 2021).

Enzymes in Drug Development

Pharmaceutical companies have increasingly incorporated enzymes into drug formulation processes to enhance bioavailability, drug delivery, and targeted therapy. Enzymes such as proteases and lipases improve drug absorption, while polymerase enzymes play a crucial role in nucleic acid-based therapies, including gene editing and mRNA vaccines (Infinita Biotech, 2025). Furthermore, engineered enzymes are now being utilized in prodrug activation, where inactive compounds are converted into active therapeutic agents in specific tissues, reducing side effects and improving treatment precision (Goyal & Kumar, 2013).

Diagnostic and Clinical Applications

The medical field heavily relies on enzymes for diagnostic applications, particularly in biosensors and rapid testing kits. Glucose oxidase is widely used in diabetes monitoring, while peroxidase-based assays are crucial for detecting biomarkers in cardiovascular diseases and cancer (Creative Enzymes, n.d.). Advances in enzyme immobilization on biosensor platforms have improved sensitivity, specificity, and real-time monitoring capabilities, revolutionizing personalized medicine (University of Manchester, 2025).

Challenges and Future Perspectives

Despite their numerous applications, enzyme-based therapies face limitations such as:

- **Enzyme stability issues**, particularly in harsh physiological conditions.
- **High production costs** due to complex purification and recombinant expression systems.
- **Short half-life**, requiring frequent administration or encapsulation in protective carriers.
- **Potential immune responses**, leading to reduced therapeutic efficacy over time (Brito & Singh, 2021).

To address these challenges, researchers are exploring nanotechnology-based enzyme carriers, enzyme fusion techniques, and synthetic biology approaches to enhance enzyme performance. Recent breakthroughs in CRISPR gene editing have enabled the engineering of highly specific enzymes for precision medicine, offering new treatment possibilities for genetic disorders and cancers (University of Manchester, 2025).

Overall, enzymes continue to play a transformative role in medicine, with ongoing research paving the way for more efficient and accessible therapeutic solutions. As biotechnology advances, enzyme-based treatments are expected to become even more cost-effective, personalized, and widely applicable in clinical practice.

CONCLUSION

Enzymes have revolutionized modern medicine, providing innovative solutions for disease diagnosis, treatment, and pharmaceutical development. Their ability to act as highly specific biological catalysts has enabled advancements in enzyme replacement therapy (ERT), drug formulation, and diagnostic biosensors, significantly improving patient care. The continued development of enzyme-based therapies, particularly in treating genetic disorders and metabolic diseases, underscores their indispensable role in clinical medicine (Brito & Singh, 2021).

Despite their immense potential, enzyme therapies still face challenges such as stability issues, immunogenic responses, and high production costs. However, recent progress in biotechnology, synthetic biology, and nanomedicine has opened new avenues for overcoming these obstacles. Techniques such as enzyme immobilization, protein engineering, and CRISPR-based modifications offer promising solutions to enhance enzyme efficacy and longevity in therapeutic applications (Chen & Zhang, 2021; University of Manchester, 2025).

The future of enzyme-based medicine lies in the integration of genetic engineering, bioinformatics, and precision medicine, leading to more personalized and efficient treatment strategies. As enzyme research continues to evolve, its applications are expected to expand across various medical fields, further bridging the gap between biotechnology and healthcare. By optimizing enzyme stability, reducing production costs, and improving targeted delivery systems, enzyme therapies will likely become more accessible and transformative in the coming years (The Business Research Company, 2024). In conclusion, enzymes will remain a cornerstone of medical advancements, with ongoing innovations ensuring their sustained impact on therapeutic and diagnostic practices. Future interdisciplinary research will be crucial in maximizing their potential, ultimately shaping the next generation of enzyme-based medical technologies.

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Examining the Importance of Education Management with the Approach of Building a Culture of Commerce and E-Economy in Afghan Society

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The growth and development of Afghanistan's communication system, despite being mountainous, has been very rapid. It is now growing at a rapid pace using modern technologies, and more than 80% of the country is covered by GSM 1 telecommunications. In Afghanistan, more than 80,000 people own telephones, and 80 times this number also own mobile phones, and most of the people's payments are made via mobile phones. A new service that has emerged in Afghanistan is the electronic payment service for people via mobile phones, which is discussed in this article. Due to its security and people's trust in it, it has attracted a large wave of people. More than 2,400,000 people in Afghanistan are Internet users. Afghanistan has made significant progress in the field of telecommunications, which is confirmed by the activities of 6 private and government telecommunications companies.
This article attempts to discuss education and culture building for the development of Afghanistan's e-commerce and economy, given the importance of culture building and education for everyone in Afghanistan, overcoming the illiteracy crisis and becoming an innovative country in the region, along with improving the quality of life and educational progress.
***Keywords**: Culture Building and Education, E-Commerce*

INTRODUCTION

Today, presence in global markets with the help of successful and efficient methods that reflect the economic capabilities of countries is one of the necessities of adapting to the current international system in terms of the progress achieved in its economic and industrial fields. Undoubtedly, the use of information technology is one of the necessary links to increase commercial efficiency in the national economy.

However, the acquisition of such a process requires dynamic measures and initiatives to reform the structure and eliminate environmental barriers. In order to remove these barriers, one of the solutions that needs to be considered is the dissemination of the culture of using commercial facilities and familiarizing all business sectors with the use of such facilities.

Without a doubt, the wise use of e-commerce technology can help us improve commercial efficiency and be more active in the field of global trade and help strengthen the country's position in regional and global markets, especially at a time when Afghanistan is joining the World Trade Organization, so it is very important to achieve this technology.

The Islamic Republic of Afghanistan is a young country in need of growth and development in the field of e-commerce, which is a prerequisite for economic development to achieve its development goals. In this article, an attempt has been made to briefly introduce the education, culture, and e-commerce and the reasons for the expansion of e-commerce in Afghanistan, and to provide appropriate solutions for the expansion of telecommunications services in Afghanistan and especially after that. In order to develop these services in the country's development program, the Islamic Republic of Afghanistan approved a document.

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In this strategic document, it allocates almost half of the budget of the National Development Program to two ministries: Education, Information Technology and Communications as equipment, improving the quality of life of the people in accordance with global indicators, combating, eradicating illiteracy, raising the level of literacy in the community and achieving global indicators, security, and development, which in recent years have witnessed good results in this program.

2. STATEMENT OF THE PROBLEM:

To begin the discussion on "Public culture building and citizen education in the development of e-commerce and e-economy with the approach of the Islamic Republic of Afghanistan", we need to recognize the factors and variables associated with it. Accordingly, in the first part, we will briefly discuss "culture", "e-commerce and e-economy", and in the second part, we will discuss the slow pace of e-commerce development in Afghanistan and its obstacles and provide a solution to expand this matter.

2-1 - Identifying and defining the factors under study

2.2.1 - Culture

Cultural development is the cornerstone of any change in society, and is an undeniable necessity. The collection of knowledge and suggestions, attitudes, manners and values of a nation is considered culture, hence any activity under the title of culture building should be carried out with the aim of influencing these matters.

Researchers believe that the speed of the existence of phenomena in the world we live in is due to the expansion of science, because as science grows, it again gives birth to other things and certainly changes time. When time is changed, space is also changed.

These are two sides of the same coin that are interdependent. Understanding public opinion will play a very important role in the process of culture building. For this reason, since the culture and behavior of a society are the result of the new thinking and thought that dominates the minds of the people of that society, the change and expression of the culture of a society is possible by changing the thought and expression of the people of that society.

To the set of opinions, ideas and beliefs that cause the emergence and creation of behavior in humans. Culture is a set of opinions and beliefs, provided that these opinions and beliefs have two main characteristics:

l - Accepted and accepted by the majority of the people in society

2 - Acceptance of these opinions and beliefs is necessarily dependent on being transferred or proven in a scientific discussion and study. Most human behavior, whether insignificant or very important, is based on cultural beliefs. Every person, by carefully observing the actions and activities he performs during the day, realizes that only a handful of his behaviors are based on "calculations and reasoning" and the majority of them are based on cultural beliefs.

In addition, the same few behaviors that are based on calculation and reasoning are themselves affected by cultural beliefs, so culture is considered the basis of human behavior, and therefore a significant part of economic behavior is also based on this foundation.

According to Harvard Business Review, the challenges of entering the 21st century are not only cultural challenges, but also technical challenges. The challenge is to adapt the tools and methods of this phenomenon to the culture, spirit, and knowledge of the people. People who have been accustomed to traditional methods for years and are not easily able to abandon them, many of them still do not trust

electronic systems and consider the use of these systems impractical and superficial. Therefore, in order to progress in the field of electronic commerce, society needs to build a culture.

3. ELECTRONIC COMMERCE AND ECONOMICS

3.1. (Definition)

General definition of commerce: Any type of offering of goods or services, which is usually (but not always) done for money. There are many definitions of electronic commerce. In fact, there is a wide range of definitions and concepts for electronic commerce that cover various topics, applications and models.

In some of these cases, an attempt has been made to provide general definitions, while in other cases, the definitions have focused on the activities, communication facilities and equipment used, the organizational scope, activities and infrastructure:

3.1.1- Definition of electronic commerce from Clarke's perspective

Any exchange of information related to business affairs by electronic means, including telephone and fax (1991).

3.1.2- Definition of electronic commerce from the perspective of the European Union

First definition: "Doing business electronically" (1990). Definition Second: "Any form of commercial exchange in which interested parties interact electronically instead of through physical exchanges or direct physical contact." (2001).

3.1.3 Definition of electronic commerce from a communications perspective:

The transformation of services, goods and information products through telephone lines, computer networks and other means of communication.

-3-l-4 Definition of electronic commerce from a commercial perspective:

A tool that enables various businesses, their partners and their customers to improve issues such as quality of service, speed of delivery and reduce issues such as costs.

-3-l-5 Definition of electronic commerce:

The interaction of communication systems, data management systems and security that enable the exchange of commercial information in relation to the sale of products or services.

4. History of Electronic Commerce

The use of electronic technologies in conducting business has a relatively long history. In fact, the need for electronic commerce arose from the demands of the private and public sectors for the use of information technology in order to achieve customer satisfaction and effective coordination within the organization.

It can be said that this new business began around 1965, when consumers were able to withdraw money through ATM machines and make their purchases with credit cards. Before the development of Internet-based technologies in the early 1990s, large companies began to create computer networks with specific, limited and standardized connections to exchange business information with each other. This method was called Electronic Data Interchange (EDI). In those years, the term electronic commerce was synonymous with electronic data exchange.

The creation and development of the Internet and the World Wide Web created new opportunities for the development and advancement of electronic commerce infrastructure and applications. According to the professors, the leap in information technology has passed through two twenty-year periods and has now entered the third period.

*1955-1974: The era of electronic data processing - EDP

*1994-1975: The era of management information systems (MIS)

*1995-2020: The Internet era (Internet)

Every twenty years, electronic commerce facilities have been provided in accordance with the capabilities of information technology of that era. While ATMs and credit cards were introduced in the first twenty-year era, in the second era, the possibility of using electronic data interchange (EDI), the international banking system (Swift) and electronic funds transfer (EFT) was provided.

However, the development of the Internet and its commercial applications has caused a fundamental change in this process, so that in the evolutionary process of electronic commerce, a noticeable distinction can be made between traditional and new Internet electronic commerce.

5. Barriers to the development of e-commerce and e-economy in Afghan society

The challenges facing Afghanistan in reaching this stage are as follows:

1. Security - an obstacle to building ICT infrastructure in remote areas.

2. Literacy - High illiteracy rates reduce the immediate impact of internet use.

3. Corruption - puts a huge strain on the legal trade process.

4. Human resources and skills - Insufficient ICT workforce is considered another obstacle to the adoption and improvement of the aforementioned technology.

In particular, low literacy rates and limited mobility are considered serious obstacles to people's access to such services. If the above-mentioned issues are addressed by the government, in the first stage, ensuring the security of the people and building infrastructure related to communications in the regions by the private and public sectors, the next steps will be taken with well-written plans, people's habits will also be overcome with culture building and initial training, and the rate of acceptance of this matter will also be determined according to the two theories of Rogers and Shoemaker. 50% of the people in the society will resist this innovation and will be among the slow and late adopters, while 50% of the people will be early adopters of innovation.

Considering the obstacles mentioned above, it is not possible to mention all of them in this article, so in this article, considering that it takes steps in the two realms of culture, education and e-commerce and prevents me from examining other issues such as security and administrative corruption, this article will only deal with these issues.

6. CULTURAL ISSUES

First of all, I must say that we cannot address cultural concerns in Afghanistan without considering the quality of life of the people, which has the global indicators of 0. Therefore, in the first step, we must first measure the requirements of digital life and then raise the level of media literacy. These indicators, which are organized and presented by the United Nations, consist of three factors: life expectancy, decent standard of living, and knowledge.

*The third factor of the indicators: the knowledge factor.

*Commitment to education.

*Literacy and the level of attendance in the formal education program.

* Technology: dissemination and creation.

In the meantime, the effective role of education as the most prominent category in Afghanistan with regard to the third indicator should be mentioned. Therefore, this article has tried to point out the position of education (gaining knowledge) in accordance with the factor and success that Afghanistan has been able to achieve, and then cultural issues are discussed. Based on research conducted in society, the factors effective in the non-acceptance of e-commerce and e-banking in Afghanistan are divided into two main factors:

l - People's lack of trust in transparent banking in Afghanistan.

2 - Livelihood and educational-cultural factors.

6-1 - People's lack of trust in the banking system in Afghanistan

The concept of trust in the traditional banking system of Afghanistan has been very bleak due to the instability of the country in the past 30 years, and there are constant concerns about financial corruption and security in this system. Based on this, merchants, as the main stream of trade and large businesses, do not use the banking system due to the lack of security and possible misuse of their financial resources.

Fortunately, in Afghanistan, all private and public banks offer parts of e-banking services and are developing it day by day, and if you are a If you have a bank account, you can easily transfer money online from anywhere in the world.

6 2- - Livelihood and cultural-educational factors

All scientists and researchers are aware that every communication and every new means in a country that requires growth and development, education and culture-building have an important place, but the fact that education must start from the lowest levels to achieve this success should not be ignored; Like developed countries that start with education for young people to achieve long-term development, Afghanistan should be divided into two groups in terms of education:

A) A group that has not yet completed primary and elementary education (illiteracy crisis)

B) A group that has completed primary and elementary education and is waiting to learn the fields of electronic sciences. (Modern illiteracy)

But unfortunately, the number of the first group is much greater than the second group due to security crises, so in Afghan society, the facilities of both groups must be prepared. The government in the country has taken valuable steps to discuss public education, but it must be said that unfortunately the government does not have access to all educational facilities due to the lack of sufficient security in the country and the destruction of infrastructure.

But the rapid growth of television and mass media and everyone's access to it has provided a good opportunity for the government to create government educational networks with the right framework and in accordance with the country's ancient culture and in line with promoting and familiarizing people with modern electronic services that are the country's needs today, for modern literacy (to focus on education from The distance, which is the only way, to combat the crisis of illiteracy, which can be achieved by providing the necessary platforms to access education from anywhere in the country (and take action to

build culture) and to reduce the number of internal networks that are dependent on political figures and have been created to promote the culture of nudity and false Western democracy, not education. Here I must say that the people of Afghanistan, considering the ongoing wars in the country and the extensive migrations that people have had to most European, American and even Australian countries, etc., and this vast wave of migrations to different countries, has caused the acceptance of such technologies for this group of people, considering the culture of those regions and appropriate to the conditions, often happened spontaneously, but the people who have been and are living inside the country, due to the crisis, still do not have much awareness of these technologies.

In the author's opinion, educational and cultural mobilization should be carried out, and considering the widespread wave of illiteracy in the country due to long-term wars and lack of educational facilities, educational issues should be addressed first in order to develop culture. In order to eradicate the widespread wave of illiteracy, the first category of primary education should be given, which is:

Science-centered: It is considered the cornerstone of cultural development in the country and causes culture building. Afghanistan, as a country with a five thousand year cultural history, has and has great capacities for cultural development and culture building. It is also a country where 99% of the population is Muslim. It nurtures a young generation, which is important in itself, because the young generation is promising for education and rapid acceptance, a generation that can easily understand education according to its position in society and progress and easily implement education for the process of cultural development. Afghanistan's civilizational history and literature, its religious culture, are focused on designing the science-centered phenomenon, as a definite, unparalleled and decisive value.

Given the many internal and external wars in Afghanistan, the only way to progress and comprehensive development, in the author's opinion, is to value knowledge and appreciate the country's scientific capital.

Currently, the Afghan education system has enjoyed relatively favorable growth and development, which we are happy that a few years ago, the United Nations ranked this education system in the first place among South Asian countries in terms of the highest human development, one of the characteristics of which is the quality of the education system, among countries such as India, Pakistan, etc. It has the most development.

The country's education system, including (government centers and seminaries), has about nine million people and is engaged in their upbringing and education. And if the investments and financial costs have paid off and a significant number of them have achieved academic degrees and certificates.

It leads to a great theorist in various fields, then we can safely say that this effort and investment have paid off and the education system has received its reward. The conclusion is that: the realization of cultural development depends on the emergence and manifestation of creativity, and this phenomenon itself is the product of scientific belief and its extension to society.

There is no easier way to overcome the high level of illiteracy in Afghanistan, which is estimated at 60% nationwide. Regardless of the method adopted, it will certainly take years to achieve an acceptable level of literacy in advanced economies in this country.

But the connections between employment, economic growth, welfare, and literacy are very clear - Afghanistan will not have a stable economy until That does not make significant progress in raising literacy rates. Now that the infrastructure and applications of information and communication technology are accessible to more than 88% of the country's population, the government should increase the scope of education by promoting distance learning and take it to the aid of the private sector, which has played a major role in the country's progress.

In many emerging markets – for example, in Egypt – the challenges of education are being addressed by providing access to distance learning for all school-age children on a mandatory basis. The strange thing about technology is that even the youngest children have a remarkable ability to quickly adopt new technologies to the extent that they can teach better than their teachers and parents.

Education and culture foster workforce participation, democratic processes in society, and strengthen social structures and security. The civil unrest and armed conflict between 1996 and 2001 and 2021 had completely destroyed or damaged all aspects of life, social, economic, and cultural infrastructure in Afghanistan.

The mechanisms for delivering social services, including education, were also largely disrupted and even collapsed. Less than a million boys were being taught in 3,400 public schools by 20,700 teachers, and the education system at that time was not responsive to the needs of the people.

6.3 - The role of education before and during the war

States play a constructive role in the process of using modern technologies and forming a structured and reciprocal relationship with the people, but if we look at Afghan society during the war and take a look at the system of that time, we may witness more destruction than reconstruction:

- There was no single, national, and standardized curriculum and standard textbooks.

- 38 vocational and technical schools were partially active, with 1,500 students and 50 male teachers teaching in them.

- Only 22,000 male students were educated in literacy courses annually. - Only 7,900 students were enrolled in 15 higher education institutions.

This is a manifestation of the lack of education and lack of culture among the people and citizens of the country, which still exists in some provinces of the country. If the government wants to take a valuable step in this area, it must act regardless of the region and tribe that have existed in Afghanistan for years.

6-4 - The Status of Education After the War

6-4-1 - Educational Facilities Created in the Country

Since 2001, we have witnessed that the Ministry of Education has pursued fundamental reforms and achieved significant achievements, but such progress has only occurred in large provinces and not in small provinces and cities. This is due to the lack of a fair educational system, which, if we look at advanced societies, should first have a fair and honest educational system.

- An eightfold increase in the number of teachers: "That is, today, 170,000 teachers, 30% of whom are female, are serving in the education system."

- The number of formal Islamic schools has increased to 550, and 136,000 students are studying Islamic sciences, 9% of whom are female.

- In order to strengthen public participation in order to improve the quality of education, 8,500 school councils have been established and 4,500 schools have been built with the help and active participation of local people.

Of course, these are themselves evidence of the understanding of the importance of education and culture in the society far from progress of Afghanistan. The authorities have somewhat understood the good place

of education and its sequel, i.e. culture in progress, and are seeking to compensate for this empty space, which is the result of civil wars.

In the field of primary and elementary education management, Afghanistan needs to get rid of the situation of illiteracy and, consequently, insecurity, which, in the author's opinion, insecurity is the result of extreme poverty, low income and lack of necessary efficiency in education.

Therefore, if a country wants to move forward in the direction of developing scientific, professional and security processes, raising the scientific and cultural level of the society, it must first start with fair primary education, but the question is, where is Afghanistan in terms of managing education and training as a country's culture-building and creation system.

7. ROLE OF THE AFGHAN GOVERNMENT IN MODERN ELECTRONIC SERVICES

7-1 - The Government and Electronic Citizens: A Step Towards Enabling Electronic Commerce and Economy

In order to develop electronic services and benefit from everyone's opinions in the development of the country, the government has put on its agenda the program of designing active websites, which is one of the conditions for electronic commerce, for all departments, organizations and ministries. This is a step towards becoming an electronic government. Fortunately, all ministries and departments in the whole country have a good and effective website for communicating and informing about their services. By visiting this website, people from all over the world can directly contact any of the high-ranking officials of the ministries in a completely virtual way and through emails that have been defined for all government employees, and share and solve their problems. This is a new idea, to familiarize people with electronic services, the benefits of becoming electronic, for people who were involved in political conflicts for years. Currently, all government employees have an email instead of a contact number to promote these services to the public. They can be a good start for people to get to know each other, of course, if we look at it positively.

The role of the government as the biggest supporter, governments have the ability to play a leading role in the development of sectors, industries, products and even business trends. Regarding the development of the ICT sector in Afghanistan, the government, with an open and development-oriented perspective, has well understood its benefits, but in this open and development perspective, perhaps the practical step is empty and the government should take steps to promote it:

- Raising public awareness and creating a culture of the public and institutions about the importance of ICT
- Raising awareness about the current state of ICT in the country.

- Ensuring security and privacy - Designing a strategic plan for e-government.

- Improving e-governance to provide services effectively, reduce bureaucracy and combat corruption. In this regard, the role of awareness, culture and assurance that lies behind trust should not be ignored, a confidence that, after the corruption of Kabul Bank, has made people distrustful of a fair and transparent banking system.

By integrating resources to create an ICT sector in public sector institutions, the government should accelerate the private sector in developing the ICT sector, both through contracting and through their participation in policy and communication processes. When the ICT market grows, it will resemble the relationship table as shown in the table below:

Table: Established connections in government

	Government	**Consumer**	**Business**	**Education**
Government	G2G	G2C	G2B	E2G
Consumer		C2C		
Business	B2G		B2B	
Education		E2C		E2E

These relations are already known and it is the duty of the Information and Communication Technology Council of the country to support the development and expansion of these relations in Afghanistan.

Afghanistan has approved the creation of a free market economy in the Council of Ministers to achieve electronic facilities and has determined it in its annual program, which in the author's opinion is a very valuable step because in a competitive market, all private companies are present in the market and are trying to improve their services. The private sector plays a very key role in the progress and development of Afghanistan. The government is emphasizing on moving away from electronic public services and making the market competitive by transferring these services to the private sector. The provision of services, proper care, social and educational services and provision of services to citizens have been formalized and new systems have been facilitated and promoted in various forms through private and tax investment alike. The presence of 6 private companies in Afghanistan is a confirmation of the author's words.

B) The second category, overcoming backwardness, modern technologies (modern illiteracy). This training should be carried out after the initial preparation of each citizen who has completed their 12-year education, in order to provide conditions for learning modern technological sciences, which can be achieved in the form of and through:

A) Access for every resident (both men and women), at home, in school, in business, in public sector institutions, to the digital age and its connection to the national and international network.

B) Creating a digitally literate Afghanistan, supported by an entrepreneurial culture ready to finance and develop new ideas;

C) Ensuring that this entire process is socially inclusive, creating consumer confidence and strengthening social cohesion.

Afghanistan is also comparable to advanced countries in the region in terms of internet access. The low price of these services, which is over 1500 Afghanis, has also made it possible to emphasize the importance and inclusion of people in this way. In this regard, the government has taken a good approach in organizing these training courses, but there is still room for work and more courses are needed, but it must be asked why all training is conducted directly and through seminars, conferences and official programs of this kind, and is only for students and not the general public, when this training can also be provided to the general public through advertising. It provided that there are about 700 printed publications in the country and it is a good way to promote.

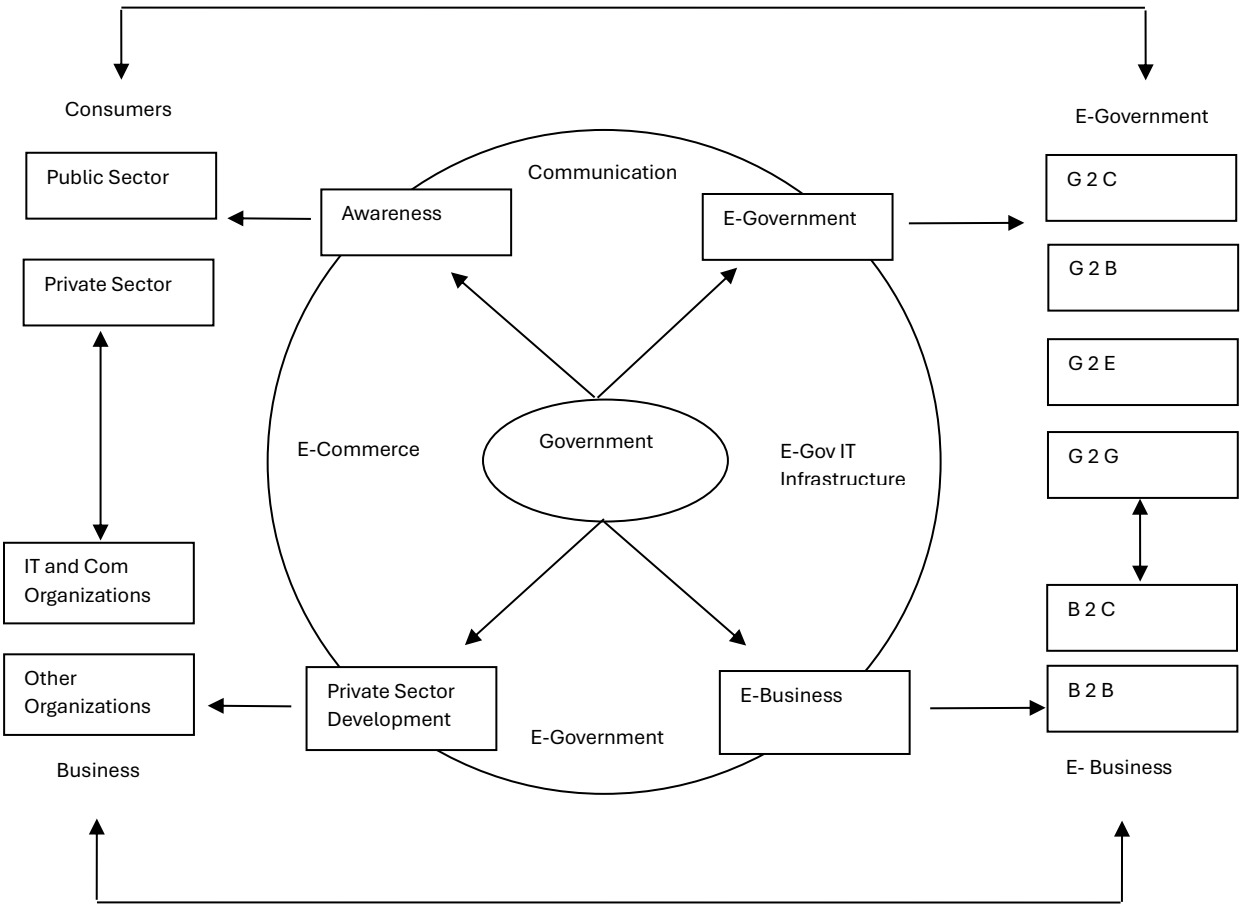

Figure 1. The role of government in the process of electronicization

8. EDUCATION AND CULTURE BUILDING IN THE PUBLIC

Fortunately, good work has been done, but if it is given more attention, is continuous, and is for the general public, its benefits will be greater. However, not much activity has been done to promote and disseminate culture for various aspects of electronic services and to consider public culture building and citizen education, which is generally discussed, and the training has only been direct, so it is necessary to put it on the agenda in three ways:

1. Direct.

2. Culture building through the mobile lens.

3. Advertising.

8.1 Directly

What is referred to here as direct education is not education for the general public, but for specific segments of society, including students. Therefore, it is necessary to familiarize people with the goals, types, and stages of electronic services and how to use them, using a variety of educational tools and educational aids, so that they themselves, by understanding the sensitivity of the issue and realizing this important point that their very large workload is greatly reduced by using electronic services, can act as promoters and marketers of these services.

On the other hand, students are emphasized as the beginning of this stage due to their high learning ability and their scientific vocabulary, which originates from classrooms, schools, and universities, and the impact of those sentences and concepts on families.

8.2 By advertising method

In order to achieve the desired and intended goals, it is necessary to use the best advertising tools and methods. In the meantime, the use of public service announcements in mass media, mainly television and newspapers, and even installing banners in the city, which is currently unfortunately only of interest to private companies and the government has no supervision over the matter, which we hope will be reflected on these advertisements. The use of public service announcements, which is a relatively new category, has received more attention since the second half of the 1980s.

To define these services, it should be stated that they are services to attract public participation in the development process, which are mainly designed and announced by the government. Among the characteristics of these announcements is their information and educational content, and not their commercial and speculative goals. Public service announcements have an open language, are indirect, and are completely artistic, so that the audience feels that this is entirely in their best interest and has a great affinity with the participatory development model. They try to strengthen this feeling and capacity in people and believe that they can do something to improve their lives. Watching advertisements (educational banners with attractive designs) is highly attractive to children, and it is good that this education and culture-building is carried out from early childhood levels. These advertisements will greatly attract children.

8.3 - Culture-building through mobile (education via SMS)

Considering the major advances in the telecommunications sector and the expansion of communication networks in the country and the access of most people to mobile phones, the question must be asked: what measures has the government taken to educate and culture-building through SMS? Unfortunately, in Afghanistan, we witness a large wave of SMS messages sent solely for commercial purposes or irrelevant SMS messages that are simply expenses that go into the pockets of operators. Therefore, given the existence and popularity of this tool among the people, it is necessary to use this popular tool for education and culture-building in society. Why shouldn't more public education be done through this medium when mobile phones have grown so widely in the country and more than 88% of people have access to these services?

SMS is a It is an educational and cultural tool that people can use without prior planning, unlike the Internet and television, which require planning and scheduling, which is one of the benefits of mobile phones. Living in the age of communication has brought many and varied blessings to people. The purpose is to use the tools and devices that are available to different people to interact with each other.

One of these tools that has a special place in Afghan society is SMS. Today, people widely use SMS to exchange news, rumors, jokes, various warnings, express emotions, and announce the arrival of events. SMS is an easy and convenient tool for most users who may not use popular social networks such as Twitter and Facebook. SMS is a simple and fast tool for all people. About twenty years ago, on December 3, 1992, the first SMS was sent via a personal computer. According to estimates, more than 1 trillion text messages are sent in the United States every year, which means that 88,000 text messages are sent per second.

Various statistics have been given in the country about text messages. For example, on occasions such as Eid al-Ghadir, Eid al-Nuruz, and Eid al-Adha, the number of text messages sent by people reaches millions, which shows that this communication opportunity is desirable and appropriate for the people of our society and has almost become one of the important communication tools in our society.

For this reason, all of us may witness various text messages sent to us by commercial and advertising companies in our daily lives. In addition, occasional text messages also play a prominent role in this area. We should be aware of the fact that text messages may occasionally contain content that affects our thinking and beliefs.

9. ADVANCES IN E-COMMERCE BY THE ISLAMIC STATE OF AFGHANISTAN

While computer use is considered an important ingredient and a prerequisite for the development of an information economy, due to the lack of data, it is very difficult to say to what extent Afghan commerce has moved beyond its traditional form and transformed into a contemporary form of commerce. Although it is very difficult to provide an exact percentage of computer use in trade, traders' access to the Internet, and trading with the site.

But what is evident is that it is following an upward graph. The figures show that 20% of traders use computers, 10% of traders use the Internet, and only a very few traders, whose number unfortunately may not exceed 1555, say goodbye to traditional trade, but it goes without saying that it shows a positive trend. There are several reasons such as illiteracy and low literacy, as well as their lack of skills in this area, which are among the obstacles to the promotion of ICT.

9.1 Better than Cash Alliance

The Afghan government's joining the "Better than Cash" alliance can guide it in its national development programs in a positive way. Electronic payments can provide lasting benefits to the people by creating opportunities to access formal financial services and initiate asset development and sustain it for the future by switching to cash payments. Electronic payments in programs that currently distribute cash or goods to poor people can save costs, increase transparency, security, and stimulate economic growth.

For example, a recent report by the World Bank found that governments could save up to 75% of their costs by switching to electronic payment systems. We see the importance of accelerating the use of secure electronic payments as a solution to expand financial services, increase transparency, and create a safe environment for citizens."

By the end of 2012, more than 70 percent of government employees received their salaries electronically, compared to less than 1 percent in 2006. The government's mobile service has been a good example of how to make cash payments electronically, but there is still a lot of room for improvement.

While less than 5 percent of Afghans have bank accounts, about 75 percent of the population has access to mobile phones, and nearly 75 percent of the population lives in areas with mobile phone coverage. This system offers real benefits for governments in terms of transparency, accountability, security, and greater efficiency and cost savings in the long run.

But perhaps the greatest benefits are for those citizens who, with little time and money, are making a big difference in their lives. Their vitality creates; for those for whom security is important, as well as for those who use electronic payments to start preserving and exploiting economic opportunities.

9.2 M-paisa

As the first mobile wallet provider in Afghanistan, it provides users with the ability to connect to a range of financial transactions in a secure, convenient and transparent manner. Using M-Paisa, customers can access their bank accounts directly from their mobile phones and perform operations such as withdrawing money, purchasing items from merchants, receiving and paying loans, purchasing recharges, receiving salaries and also paying bills from the comfort of their homes.

10. Solutions

Electronic Afghanistan is not a fantasy or a dream. It is the result of proper planning and use of the country's existing facilities. Electronic Afghanistan accelerates the development process and causes economic prosperity. Statistics and results show that countries that have entered the electronic world and digital trade have also gained huge profits. In Asian countries such as Malaysia, Singapore, Thailand, Indonesia and the Philippines alone, more than 1 billion US dollars are added to the economic revenues of these countries annually. Among these countries, Malaysia has been the best at equipping its economy with the digital world and achieving a profit of more than 1 billion US dollars per year.

The pace of joining the electronic world in Asia has accelerated greatly since 2000. The United States of America is the leader in electronic trade with a volume of transactions of more than 800 billion US dollars per year, followed by European countries and Japan, which have gained a greater share in conducting electronic trade transactions and are in the next ranks. Statistics say that about 25 to 30 percent of international trade transactions are now conducted electronically. In 1999, about $11.5 billion was transferred through e-commerce, and in 2003 and 2004, this figure reached nearly $40 billion. It is said that with the increasing expansion of this new trade, about 80 percent of world trade transactions will be electronic by 2050. According to the statistics and information mentioned, the lack of planning for the use of this new technology in Afghanistan continues to keep us economically backward.

Experts believe that third world countries can grow their economies by using the electronic world and raise per capita income to the level of income of people in advanced countries. Now we must ask what is e-commerce or its broader form, e-Afghanistan? What facilities do we have to implement it in the country, What facilities do we need, and how can we take practical steps to create it?

In short, e-Afghanistan is an Afghanistan where formal and informal communication in sending and receiving messages, processing and executing data; is done through local and international networks. Also, electronic exchange of goods and services, electronic transfer of money through electronic banks, electronic exchange of documents, negotiations, contracts, marketing are part of this great project. Electronic Afghanistan should have comprehensive information about cities and villages along with their human and natural resources. In all these cases, we need the following:

10.1 - Creating and compiling legal rules for electronic communications, including validating electronic documents and signatures, special customs laws, and laws that guarantee the rights of buyers and sellers

This section should be carried out by the government, and given the global nature of communications, the laws should also be equal to global standards. For example, in some parts of the work and operations of Electronic Afghanistan, in case of violation, there should be the possibility of prosecution by the police. Having an efficient police force to identify and track violators is one of the programs that the government is responsible for.

10.2- Building Afghan Electronic Databases and Networks

Electronic databases can be Afghan websites that, in addition to displaying information and being able to exchange it, also have the possibility of buying and selling goods and services (Store) Online. Electronic networks also provide individuals with access to the necessary information and data.

10.3 A banking system that can cover online buying and selling

The banking system should put electronic services on its agenda, and banks should provide online services to enable money transfers between individuals. Usually, this is possible with the presence of credit cards

(Credit). Credit cards should be functional both inside and outside the country. Providing international credit cards such as Master Card (Master) and Visa (Visa), as well as cards that cover domestic transfer networks, should be offered by private and government banks. Electronic banking laws can be made by the government and the private sector in compliance with international standards.

10.4 Existence Powerful communication lines that connect computers to the Internet

Companies that provide this service are known as (lISP). These centers connect a certain number of computers to the network at a standard speed, depending on their bandwidth.

-10.5 Educating and informing people through news media and even the possibility of introducing it into the country's educational system in schools and universities:

Electronic Afghanistan is a new and novel phenomenon that can be understood through public education. Electronic Afghanistan has certain complexities that are mostly related to the stages of its construction. Using the facilities of this living digital world of Karar Chanderdan is not a problem, and even in itself it has certain attractions for people that provide interest in it during education.

10.6 Information and data security

People should exchange their information with ease and confidence that it is confidential. Just as laws have ensured the protection of telephone conversations and postal packages, they must also expedite the electronic transmission of data and messages. Also, to increase the security of networks, security software such as VerySign is used. This part must also be provided by the government and domestic and international coverage networks.

Fortunately, cheap and fast Internet technology is available in the country, and it can be said that part of the possibilities of electronic Afghanistan, which is connecting computers to the network, is available in the country. Another part that requires creating a domain, providing space and the ability to manage it or hosting (Web Hosting) and designing is also possible within the country. UNDP or the United Nations Development Program has created the possibility of registering domains with the extension (www.yourname.af), which is the abbreviation for Afghanistan, for the Ministry of Telecommunications.

But unfortunately, this ministry has limited its use to a few government departments and large companies with an unreasonable price of one thousand US dollars per year for registering a domain with the extension .AF. While registering the domain .US, which is the abbreviation for the United States, is possible for only 25 to 50 US dollars per year. Of course, registering international domains with .Com extensions, etc., is also possible at a low price in the country. Unfortunately, modern banking has not yet come to life in Afghanistan and is managed with traditional systems.

The situation of private banks is similar to that of state-owned banks. Although other private banks in Afghanistan have created the possibility of checking accounts on their websites, they have not yet put advanced banking services and credit card issuance on their agenda. Several foreign banks also operate in Afghanistan.

These banks are responsible for most of the financial turnover of foreigners and international organizations, which will not bring any economic benefit to our country. In any case, now with proper management of facilities and legislation and the creation of an electronic Afghanistan, it is possible to encourage a large number of Afghan users to be active on the network. Fortunately, there are many Afghan users who use the Internet.

However, the lack of specific and sustainable educational programs has limited the use of the Internet in the country to the basic level of using this powerful technology, such as sending emails, chatting, and visiting a few news and music sites, which means that almost 50% of Internet surfing in Afghanistan is a waste of time and money.

CONCLUSION

Many economists, experts and futurists believe that in recent years a revolution similar to the industrial revolution has taken place, which has brought the world into the "information age" and has undergone a dramatic transformation in many economic, social and cultural aspects of human life.

One aspect of this transformation is the profound changes that have occurred in the economic relations between individuals, companies and governments. Commercial exchanges between individuals, companies and governments have rapidly moved away from their traditional form, which is mainly based on paper-based exchange and are moving towards exchanges through the use of electronic information systems.

E-commerce has opened a new arena in competition due to its speed, efficiency, cost reduction and exploitation of fleeting opportunities, to the extent that it is said that falling behind the pace of development will result in isolation in the global economy.

Today, large stores easily sell their products via the Internet, and companies have made their huge financial transactions on the Internet. Investment, electronic marketing, electronic payments, online stores, large auction and electronic markets are included.

But unfortunately, what our beloved country Afghanistan is experiencing is a growing gap with advanced and even developing countries. There are long-term internal and external wars and the lack of a suitable platform and it is emerging from different directions. And every change in people's lives requires a culture building, which good steps have been taken directly, but it requires public awareness of the society. If we look at security issues in some insecure areas of the country, the best solution for public education and culture building, and the most effective of them, considering the progress of communication platforms in the country, should be done via mobile phones and sending SMS, in addition to television. Therefore, it seems necessary to study and research the factors preventing the proper growth of e-commerce in our country, Afghanistan.

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The Strategic Role of E-Commerce in Supply Chain Management

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Nowadays, organizations have turned to using various tools to gain competitive advantage. One of these tools can be considered information technology in the field of trade. The increasing advances in information technology have been able to create strategic changes in e-commerce and consequently in supply chain management. This article, by examining research in the field of e-commerce and supply chain, explains the strategic role of e-commerce on supply chain management. E-commerce can be considered a platform for improving supply chain performance, because the use of this tool can lead to cost reduction, improved scheduling, and system coordination.
***Keywords**: E-Commerce; Supply Chain Management; Strategic Management; Information Technology.*

INTRODUCTION

Today, e-commerce can be considered a new way to improve business activities. Later, e-commerce became a strategic tool for small and large organizations. Also, with the increasing penetration of the Internet in all business processes, many experts predict that e-commerce will become the mainstay of the economy. The recent development of e-commerce has also contributed to the expansion of the logistics market, which promotes the development of logistics-related technologies. A large number of measures have been taken in the field of e-commerce logistics. (Ramanathan et al.2014)

Also, the daily progress of information technology in the field of e-commerce has enabled managers to gain significant mastery in integrating supply chain management. E-commerce facilitates coordination between supply chain components by designing electronic-communication systems of the organization or partners. Thus, in today's market, where competition is based on time, product quality, and on-time delivery of products to the customer (customer satisfaction), coordination between suppliers, distributors, and other components of the supply chain is very important for predicting and planning the delivery time of goods and services continuously and brings many competitive advantages.

Therefore, e-commerce is not only responsible for creating changes in supply chain management, but also allows for better information flow in various forms, including electronic data exchange, direct communication with suppliers, so that organizations can improve their competitive position with advantages such as increasing the speed of data transmission, reducing errors and increasing the accuracy of received and sent data, reducing inventory, planning logistics, controlling inventory, reducing the delivery time of goods, and improving their competitive position. (McIvor.et al. 2003)

Usually, every company has a fully integrated supply chain that ensures the uniform output of products and their timely delivery. This feature has taken on a new meaning with the advent of e-commerce, where the supply chain function may be destroyed or create a new organization. Supply chain management encompasses the business processes of manufacturing, sourcing, transporting, and physically delivering goods to end users.

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Effective supply chain management integrates all these processes in a smooth, coordinated, and efficient manner. In addition to company departments, supply chain management works with partners that include distributors, airlines, third-party companies, and information systems providers.

The supply chain is the most important element that must be implemented quickly, seamlessly, and securely for companies to thrive in e-commerce. However, hundreds of e-commerce companies are competing for market share, each identifying and developing innovative sales and delivery strategies (Sreenivasulu et al.2021)

2. Necessity and Importance of Conducting Research

Today, e-commerce, and especially the Internet, through information technology, has been able to create a harmonious and harmonious relationship between supply chain members by reducing costs and time. So that the successful models of previous supply chains have quickly become inefficient and obsolete, and their management has also changed. E-commerce is probably the most promising application of information technology that has led to the growth of the global economy and plays a fundamental role in the management of the intra-organizational network of supply chain members. (Gunasekaran,et al.2002)

A competitive necessity in the business field is the integration of supply chain management with information technology in order to improve the performance of the organization. For this purpose, organizations are required to study and examine the strategies of e-commerce on supply chain management, and if this requirement is not met, not only will the organization's performance not improve, but it will also cause a loss of market share.

3. THEORETICAL FOUNDATIONS AND RESEARCH BACKGROUND

3.1 Theoretical Framework

3.1.1 E-Commerce:

E-commerce includes transactions related to the online purchase and sale of products or services. These transactions are carried out using electronic systems such as the Internet and other computer networks. The volume of these types of transactions (conducted electronically) has increased exponentially.

The penetration and spread of the Internet have fueled such development. Today, various types of business transactions are conducted in this way, such as electronic funds transfers, supply chain management, Internet marketing, online transaction processing, inventory management systems, and automated data collection systems.

Therefore, the definition of e-commerce in the contemporary era implies that if a transaction typically uses the World Wide Web at least at any stage of the transaction life cycle, it is called e-commerce. This means that e-commerce can also include a wider range of technologies such as email. (Mohapatra,2013)

E-commerce is also a new way of doing business electronically using networks and the Internet. In this method, the process of buying and selling or balancing products, services, and information is carried out through computer and telecommunications networks, including the Internet. (Hanafizadeh, and Rezaei,2010)

3.1.2 Information Technology

Information technology is a set of techniques and tools that are used to optimize and support business activities. The organization's operations are based on information and knowledge. This includes the study, design, development, implementation, maintenance and management of computer information systems that

help the organization in collecting, recording, processing, storing, marketing, transmitting and distributing information.(Sarafizadeh,2004) Information technology involves collecting, storing and organizing information on existing tools and technologies.(Esfandiari, and Shahab,2010)

Advances in the field of information technology have played a significant role in the dynamic changes of the twentieth century. Information technology allows companies to create and conduct their business operations more efficiently, more flexibly and with greater economic power than was possible in previous decades. It also enables them to respond more easily, quickly and effectively to environmental changes.(Chen,2012)

Information and communication technology is the result of the integration of the three fields of information, computers and communications. Although the concept of information and communication technology seems to be clear, in fact it is not, and different definitions of information technology have been provided by different organizations and individuals. (Behan, and Holmz,1998)

In their study, Behan and Holmes defined information and communication technology as follows: (The term information and communication technology is used to describe technologies that help us record, store, process, retrieve, transmit, and receive information. This term includes technologies such as computers, fax transmission, telecommunications, telephones, calculators, printing, and engraving. (Jafari et al.2009)

Information technology is also defined by the Information Technology Association of America as: Information technology is the study, design, development, implementation, support, or management of computer-based information systems, especially computer software and hardware programs. In short, information technology deals with issues such as the use of electronic computers and software to transform, store, protect, process, transmit, and retrieve information in a reliable and secure manner. Recently, this term has been slightly modified to clearly include the scope of electronic communications. Therefore, more people are inclined to use the term (information and communication technology.(Rezaei,, et al. 2015)

3.1.3 Supply Chain

Supply chain management is an integrated philosophy for managing the entire flow of a distribution path from the supplier to the final consumer and, as a management philosophy, includes the extent and scope of integrated behaviors for cooperation between the customer and the supplier in the process of external integration.(Handfield,et al.2000) Supply chain management as a management process includes a process of managing relationships, information and the flow of materials within defined boundaries to deliver services and economic value to the customer through the management of physical channels and related information from resources to consumption.(Stadler, and cristopher,2000) Another definition of supply chain management is: the integration of key business processes from the end user to the main supplier that add products, services and information and provide greater value to the customer and stakeholders.(Aalrdi,20017)

It is worth noting that Handsfield has defined the supply chain in a different way: the supply chain includes all activities related to the flow and transformation of goods from the raw material stage to the final state, as well as the information flows associated with them, and also defines supply chain management as the integration of activities related to the flow of materials and information, through improving chain relationships to achieve a reliable and sustainable competitive position.

3.1.4 Strategic Management

Strategic management is the art and science of formulating, implementing and evaluating multi-purpose decisions that enable an organization to achieve its goals. As is clear from this definition, strategic

management focuses on the integration of management, marketing, finance and accounting, production and operations, research and development and information systems to achieve organizational success.

The term strategic management is used synonymously in this text with the term strategic planning. The latter term is more commonly used in the business world, while the former is often used in academia. The term strategic management is sometimes used to refer to the formulation, implementation, and evaluation of strategy, and strategic planning refers only to the formulation of strategy.

The goal of strategic management is to exploit and create new and different opportunities for tomorrow. Conversely, long-term planning attempts to optimize today's trends for tomorrow.(Fred and David, 2010)The strategic management process enables managers to make decisions for the optimal allocation of resources with a long-term perspective.(David,1993)

3.2 External Background

With the advent of the Internet and its commercialization since 1994,(Peterson, et al.1997) a new business medium, commonly known as "electronic commerce", has rapidly emerged in the modern global economy.(Poon, & Jevons,1997) E-commerce can be defined as "the use of the Internet and other network technologies to conduct business transactions".(Turban, et al.2004)

Moreover, e-commerce not only involves online buying and selling, but also includes a set of activities that span the value chain of a company, such as promoting products and services on the Web, integrating billing and payments from customers, secure transactions, and handling customer inquiries online.(Kalakota, & Whinston, 1996) In short, e-commerce is a concept that integrates a wide range of existing and new applications.(Zwass,1996) Based on the type of applications, e-commerce can be classified into three categories:

1 Business to Business (B2B).

2. Intra-organizational (intra-business).

.3. Business-to-consumer (B2C).

Companies around the world have reaped numerous benefits by implementing e-commerce. Some of the benefits include improved operational efficiency and revenue generation by integrating e-commerce into their value chain activities (Brynjolfsson & Kahin,2000) access to a wider range of markets(Brunn,, et al.2002), (Essig,& Arnold, 2001),(Fariselli,et al.1999),(Senn,2004), greater potential for partnerships with suppliers and vendors, (Koch,2002),(Tumolo,2001), improved customer service, (Bakos,1998),(Burton, & Mooney,1998)24-hour availability (Deeter-Schmelz,et al.2001),(Lin & Hsieh,2000)

flexibility in management and partnerships, up-to-date information (Baron,et al. 2000),(Stanoevska-Slabeva, & Schmid,2000), lower transaction costs (Clemons,et al.1993), (Malone,1987), product and service differentiation, and the ability to enter the supply chain of larger companies. (Erbschloe,1999)

Although the use of e-commerce offers various benefits and it is widely accepted that the use of e-commerce by businesses in developing countries is an important economic indicator of growth (Molla, & Licker,2005) many companies In developing countries such as India, China or South Africa, the full benefits of e-commerce have not yet been realized.

According to Cupachino, the supply chain can be defined as follows: The supply chain includes all the activities required to provide a product to the final customer, or all the activities related to the flow and transformation of goods from the raw material stage to delivery to the final consumer, as well as the

information flows associated with them, which in a general view include the three areas of logistics, production and distribution.(Shafiee,2009)

According to Stevens, the supply chain includes a set of related activities that are related to the planning, coordination and control of raw materials, parts and manufactured goods from suppliers to customers.(Faqhi,2010)

There are several models of e-commerce that differ depending on the type of transactions that are made. For example, business-to-business, customer-to-business and customer-to-customer are some of the e-commerce models. For efficient supply chain management, business-to-business e-commerce models can be effective. To improve communication between customers and suppliers, the Internet, the Web, and electronic data interchange are useful tools for exchanging information about products and services. Many companies have little knowledge and skills related to e-commerce. This can be due to a lack of understanding of the implications of e-commerce and a lack of sufficient money to invest in this type of business. Implementing and using e-commerce requires training, as well as government support in providing easy access to Internet services and developing websites for e-commerce. (Gunasekaran, & Ngai,2004)

The Internet helps manage supply chain activities by providing information about the type of product needed, goods in stock, products in process, and items leaving or entering physical facilities or customer sites. For example, an organization's planning system through extranets provides communication not only between organizations but also between network partners, such as suppliers, distributors, and third-party logistics.(Cooper,et al.1997)

The interaction between technology and business processes is key to understanding the effects that e-commerce can have on economic transactions and ultimately on the economy as a whole. What distinguishes e-commerce from traditional commerce is essentially the method or pathway through which information is exchanged and processed between buyers and sellers.

In e-commerce, information is exchanged over a digital network or other electronic channels, rather than being transmitted through direct person-to-person contact. E-commerce may create an additional sales, marketing, or distribution channel alongside traditional commerce channels, or may create new goods, services, and markets.(Wolfgang,etal.2005)

Researchers have offered several explanations to show what factors affect a firm's adaptation to the environment. In general, we can distinguish internal and external factors related to the environment. Stakeholder pressure, environmental regulations, firm size, industry sector, geographic region, globalization, position in the supply chain, strategic perspective, management perspective, motivations, manager personality traits, and human resources are environmental and organizational variables that have been repeatedly seen in research results.(Gonzalez,et al.2006)

3.3 Internal Background

Electronic commerce has been widely welcomed by human societies in recent years. Companies and organizations that provide products and services, in line with the global developments in the field of electronic commerce, are trying to change the logical and physical structure of their organizations in this field. The development of electronic systems such as the Internet has affected all institutions and organizations and banks.

The World Wide Web has fundamentally changed customer expectations regarding speed, accuracy, price and service. Geographical distance has lost its meaning and the availability of services, ease and speed of

service distribution create a competitive advantage for organizations and institutions. In order to compete in this complex business environment, organizations are forced to provide the latest and most attractive services that customers demand.(Farajian,2006)

Electronic commerce does not mean having a website, but much more than that. There are many applications, including banking, job searching, buying and selling stocks, buying and selling in real-time markets, electronic marketing and advertising, customer service, auctions, travel services, electronic collaboration in research and development projects in electronic commerce. To implement these applications, it is essential to have supporting information and organizational infrastructure.(Hanafizadeh, and Rezaei,2010)

In today's world, information and communication technology is one of the main sources of development, and one of the most important indicators of development is the ability to produce and use information in any society. In other words, information is an indicator of power, and the amount of information that a country produces or uses is the most important factor that determines the distinction between different societies.

Information technology has been mentioned as the best tool for the dissemination (distribution and expansion) of information and communication, none of today's activities will be carried out without the use and application of information technology in the world. (Hosseini,2010)

Supply chain management is the result of the evolution of warehousing management. In the 1960s, experts were able to reduce their inventory by studying the internal relationship between warehousing and transportation and integrating them, which resulted in the name (distribution management). In the course of evolution, with the addition of manufacturing, procurement and order management topics to distribution management, the concept of logistics emerged. Then, along with improvements in production processes and the application of reengineering patterns, managers of many industries realized that in order to continue to be present in the market, only improving internal processes and flexibility in the company's capabilities was not enough; rather, suppliers of parts and materials must also produce materials with the best quality and lowest cost, and product distributors must also have a close and tight relationship with the manufacturer's market development policies. With this attitude, the supply chain management approach came into existence Institution.(Afshar,et al.2009)

The goals of modern supply chain management are to reduce uncertainty and risk in the supply chain, and yet, it has a positive impact on inventory levels, cycle times, business processes, and customer service time. This chain is a dynamic process that includes simultaneous activities, continuous assessments of the parties involved, the technologies used in it, and the organizational structure.

This technology provides customers with the opportunity to have multiple choices and increasingly access information. In general, all these factors help to transfer value to the customer and increase profitability and competitiveness. Electronic commerce is a processing technology and a set of activities that are carried out automatically in networks and through information technology during commercial exchanges.

According to different perspectives, several definitions of electronic commerce have been proposed, all of which share at least two things in common: All definitions focus on the process of buying and selling or exchanging goods and services, and the use of some kind of electronic tool is considered.(Khodad Hesni,et al.2006)

4 RESEARCH METHODOLOGY

The present study is classified as applied research in terms of its purpose because it seeks to understand the best strategy in the field of supply chain management from the perspective of e-commerce, and in terms of data collection method, it is classified as a review of library documents and documents.

5 QUESTIONS

5.1 Main Question

What is the strategic role of e-commerce on supply chain management?

5.2 Sub-questions

What is the impact of e-commerce on suppliers in adopting an optimal strategy in view of market changes?

What is the impact of e-commerce on the coordination of production and distribution systems and strategies?

What is the impact of e-commerce on improving supply chain scheduling?

6 FINDINGS

In short, the e-commerce industry will be one of the leading sectors in the field of commerce in the coming years. The revolution in e-commerce has a great positive impact on the trading industry by rapidly providing new markets and crossing borders. This has had a great impact on the global market and has improved people's lives. Although e-commerce is an advantage for customers and sellers, it is also known as an obstacle for small businesses to create a sustainable business. Developing countries face many challenges in implementing e-commerce effectively.

The affordable price of the Internet increases the growth rate of e-commerce, so many companies usually turn to implementing e-commerce. Easy access to this type of business is one of the major advantages of e-commerce for consumers and, as a result, increases customer loyalty. This is why consumers can place their orders from anywhere they are by accessing the Internet. E-commerce is essential for a company that offers integrated functionality and multiple payment options and should offer more functionality that is accessible online. (VIPIN and SATYENDRA, 2021)

This study showed that organizational performance can be achieved by effective supply chain management. Supply chain management can only be effective if it can meet various planning, inbound, outbound, reverse and order management. This study showed that organizational macro-planning are key issues that significantly affect the organization's goal. The researcher found that yield and inventory management are key issues that should be considered when studying supply chain management, especially in the e-commerce market. (Sreenivasulu,2021) Developing effective strategies to leverage competitive advantages through e-commerce will be essential for success in the 21st century.(Mohapatra,2013)

By increasing and facilitating communication between organizations, e-commerce, collaboration and reducing production cycle times as well as reducing costs by creating opportunities for international trade, it provides a basis for coordination and integration. E-commerce offers optimized supply chain management benefits to all organizations, regardless of their size and financial resources, through the establishment of a global network.

E-commerce enhances supply chain management in various forms such as electronic data interchange, direct communication with suppliers, the Internet, extranets, intranets, electronic catalogs, etc. But its greatest impact is from the Internet. The Internet has provided users with the opportunity to take advantage of this opportunity and has enabled managers to maneuver more in supply chain management and, with the

ability to integrate and integrate business activities with customers and suppliers, has created a competitive advantage for organizations. By implementing innovation in e-commerce, these changes move suppliers from a passive state to a strategic and active resource.(McIvor,et al.2003)

What has happened to business in recent decades is the change in the nature of business due to the great impact of information technology. The Internet has fundamentally changed the international trade environment. These changes may cause fundamental changes in the methods used in supply chain management.

All the discussions of supply chain management in the current electronic world are presented in electronic and internet markets. Today, we consider supply chain management as one of the basic infrastructures for implementing e-commerce in the world. In the current global competition, we have to offer various products according to customer demand. What causes more pressure is the customer's demand for high-quality and fast services, which is not the same as in the past.

As a result, it is not possible for companies to do all the jobs individually. In the current competitive market, all economic and manufacturing agencies not only consider their internal organization and resources, but also consider themselves in need of managing and monitoring related resources and principles outside the company. The real reason is to find competitive advantages with the aim of finding a greater market share.

Accordingly, some of the activities including supply and demand planning, material procurement, production and product planning, product storage, inventory control, distribution, delivery and customer service have been transferred to the supply chain level, which were previously carried out within the company. The key to a supply chain is the coordinated management and control of all these activities.

Supply chain management is a phenomenon that may do this for customers so that they can receive reliable and fast services with high quality and low cost. One of the important discussions in finding an effective supply chain is the use of electronic tools for greater coordination and integration of the supply chain. In addition, to find an effective supply chain management in this new business environment, it is necessary to recognize the main function of effective information technology as one of the important elements of information technology.

The final discussion is to pay more attention to customer needs and pay more attention to all customers of the organization. In the meantime, electronic supply chain creates a significant role in gaining more competitive advantages for the organization against competitors.(Navid,2011)

In this article, an attempt was made to study the strategic role of e-commerce on supply chain management by studying previous research in the field of e-commerce and supply chain management and to reach a comprehensive conclusion.

CONCLUSION

Today, the advancement of information technology in societies, by facilitating the stages of collecting, processing, storing and transferring information, has helped managers to achieve the strategic goals of the organization in the field of e-commerce, and information technology can also be considered as an effective factor in strengthening the foundation of the organization. In recent years, developed countries have gradually abandoned traditional methods in the field of trade and turned to e-commerce. E-commerce can be considered a suitable platform for saving time, increasing productivity, and reducing costs.

Considering the goal-setting of organizations in order to achieve goals and also maintaining a competitive advantage over competitors, the use of information technology in improving supply chain performance is

considered vital. Strategic planners must be prepared to create a set of technical solutions to advance the organization's goals.

This article examines the strategic role of e-commerce on supply chain management and ultimately explains the importance of the impact of e-commerce on the supply chain. What is certain is that organizational strategists are required to create coordination between organizational components, improve scheduling, and also examine the obstacles facing the organization in order to provide appropriate solutions.

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