

A. Kazybayeva, PhD, ass. professor¹

N. Kuttybaeva*, PhD, ass. professor²

G. Raikhanova, c.e.s., ass. professor²

A. Sadykova, master, senior lecturer³

Almaty Management University, Almaty, Kazakhstan¹

Karaganda National Research University

named after academician Ye.A. Buketov,

Karaganda, Kazakhstan²

Karaganda university of Kazpotreboysuz,

Karaganda, Kazakhstan³

* – main author (author for correspondence)

e-mail: nurg_78@mail.ru

ASSESSMENT OF THE EDUCATIONAL AND ECONOMIC POTENTIAL OF CONTENT CREATED BY ARTIFICIAL INTELLIGENCE

The article examines the educational and economic significance of multimodal content created using artificial intelligence technologies. It is determined that the use of content affects not only the quality of learning by students, but also the formation of new approaches in the digital economy of education. It is shown that the study was conducted using eye-tracking technology, which made it possible to analyze more deeply the cognitive processes of perceiving AI-generated content. It is shown that the experimental 2x2 design with the participation of 30 economics students made it possible to analyze modified and unmodified materials supplemented with diagrams and flowcharts created using artificial intelligence. The metrics of gaze tracking (duration of fixations, saccade trajectories, areas of interest) were analyzed, which made it possible to identify patterns of cognitive engagement and determine the impact of AI content on test results. The results of the study showed that multimodal materials created using artificial intelligence ensure a more even distribution of students' cognitive resources and increase their academic performance. It was found that prolonged fixation on visual elements positively correlated with the success of tasks ($r = 0.45$, $p < 0.05$), while excessive saccade length was negatively associated with learning outcomes ($r = -0.38$, $p < 0.05$). The scientific novelty of the work lies in the integration of educational and economic aspects of the use of artificial intelligence. It is shown that the development of digital technologies and their introduction into the educational process contribute to an increase in the effectiveness of personnel training, the formation of new models of educational services and an increase in the competitiveness of the knowledge economy. The practical significance of the research lies in providing recommendations on optimizing the design of multimodal educational materials and increasing their cost-effectiveness.

Keywords: artificial intelligence, educational technology, multimodal content, eye-tracking, cognitive engagement, visual aids, engagement patterns.

Кілт сөздер: білім беру технологиялары, жасанды интеллект, мультимедиялық мазмұн, көз қимылдарын қадағалау, когнитивтік қатысу, көрнекі құралдар, мінез-құлық үлгілері.

Ключевые слова: искусственный интеллект, образовательные технологии, мультимодальный контент, отслеживание взгляда, когнитивная вовлеченность, визуальные пособия, поведенческие шаблоны.

Introduction. The integration of artificial intelligence (AI) with learning is transforming traditional learning with fresh tools and processes. Generative AI tools like ChatGPT open up new possibilities for creating customized and interactive learning content to enrich the learning experience. However, AI deployment in schools raises critically important questions about reliability, ethics, and whether and to what extent AI supplements educational attainment. Also, there is limited research on the cognitive value of AI-generated multimodal materials, especially whether and to what extent they enhance understanding and memory recall. This study fills these gaps with research on how learners utilize AI-facilitated learning materials and their impact with advanced eye-tracking apparatus.

According to the McKinsey Global Institute, AI technologies could contribute an additional global gross domestic product (GDP) growth of approximately \$13 trillion by 2030, corresponding to an extra 1.2% annual GDP growth. If these forecasts materialize, AI's impact will be comparable to other general-purpose technologies in history. For instance, introducing steam engines in the 1800s increased labor productivity by approximately 0.3% per year, robots in the 1990s by around 0.4%, and new information and communication technologies (ICT) in the early 2000s by 0.6% [1].

Experts have analyzed the five most common AI technologies: computer vision, natural language processing, virtual assistants, robotic process automation, and advanced machine learning. The initial data included survey results from approximately 3,000 firms across 14 industries and economic indicators from various international organizations. The calculations indicate that by 2030, around 70% of companies will be able to implement at least one type of AI technology, and at least 50% will have fully adopted all five [1, p.16].

Many developed countries are already driven to accelerate the adoption of AI technologies to boost productivity growth, as their GDP growth rates tend to decline - mainly due to population aging. Furthermore, high wage levels in these countries increase incentives to replace human labor with machines. Leading nations in AI adoption are

converting their advancements into tangible economic benefits. Specifically, economically developed countries could gain an additional net financial benefit of 20–25% by 2030 by developing and implementing AI technologies [2]. In this context, integrating AI-driven teaching methods is becoming increasingly relevant.

The main focus of this study is to examine cognitive engagement and learning effectiveness associated with multimodal content created using AI. This study evaluates how students perceive, process, and recall material generated with AI, such as diagrams and flowcharts embedded in texts.

The experiments employed a 2×2 fractional factorial design for the proposed objectives. Cognitive processes were identified by collecting eyetracking measurements such as fixation durations, parafoveal magnitudes and AOIs. The subjects were undergraduate economics students who had already taken at least an introductory course in economics. The contents were original articles and AI-modified articles, thus, engagement and effectiveness of learning could be compared between them. Statistical analyses The data were analyzed using standard statistical method, and a reliable result that can be reproduced was obtained.

This work adds to the growing body of AI in education. It offers evidence-based guidelines to produce successful educational materials that are digitally enhanced with AI. Practical considerations in the optimization offer to minimize bandwidth requirements.

Literature review. A key sign of artificial intelligence growth is how much IT Kazakhstan ships out, which jumped in 2023. Exports should hit \$546.7 million, with \$315.4 million from Astana Hub project members. These companies exported services and products to 86 countries, including the United States (USD 118.7 million), Russia (USD 34.5 million), Ireland (USD 30.3 million), and others. Of the 1,400 registered IT companies, 394 (28%) are exporters, which underlines the country's significant potential on a global scale. Among the exported IT services, the following areas stand out: software development (hereinafter referred to as software), GameDev, SaaS (Software as a Service), corporate and platform software, and artificial intelligence. Despite significant progress, the share of artificial intelligence in total exports remains relatively low, which opens new opportunities for growth and development. The development of artificial intelligence is a new technological revolution that opens unique opportunities for Kazakhstan to accelerate the growth of IT exports, create innovative projects, and create technology unicorns [3].

According to the Global AI Report 2024, spending on artificial intelligence in 2024 will double be compared to 2023, averaging \$2.5 million per company. A PwC study shows that global GDP could be 14% higher by 2030 thanks to AI - equivalent to an additional \$15.7 trillion - making AI the most significant business opportunity in today's rapidly changing economy. According to a McKinsey report, advanced analytics, traditional machine learning, and deep learning can create additional economic value. At the same time, generative AI can deliver an additional 35–70% economic impact through new use cases and increased productivity.

The US, China, the EU, and the UK retain their leadership in creating the best artificial intelligence models. In 2023, 61 AI models were developed in US institutes, while the EU and China had 21 and 15 models, respectively. According to a PwC study, thanks to artificial intelligence, the Middle East's and developed Asia's GDP could grow by an average of 10.4% by 2030 [4].

AI technologies will largely determine countries' competitiveness and societies' security levels. The economic impact of AI may be more substantial than other general-purpose technologies. However, the positive effects of AI are likely to be delayed. Therefore, the benefits of initial investments in AI may not be noticeable in the short term. At the same time, research shows that the impact of AI on economic development will increase over time. At the same time, there is a risk of widening the technology gap between those who quickly adopt these technologies and those who do not, as well as between workers with relevant skills and those who do not [5]. Therefore, the benefits of AI are likely to be distributed unevenly. Moreover, if these technologies are not developed and implemented rationally, inequality will deepen, fueling various socio-economic conflicts. Leaders who determine AI implementation policies must use long-term strategic planning methods to overcome the negative effects of automation and digitalization of production processes. At the same time, companies implementing AI should work closely with government agencies to address the large-scale task of training and retraining personnel to work with these technologies. In turn, people in these conditions must constantly improve their skills to meet new types of employment and the needs of a dynamically changing labor market.

Main part. The rapid development of generative artificial intelligence (AI) technologies, particularly AI-based chatbots such as ChatGPT, has had a significant impact on various fields, including education. These intelligent systems offer a range of advantages: they can enrich the educational process by adapting to the needs of teachers and learners, partially fulfill instructional functions, enhance the efficiency and effectiveness of learning, and provide personalized learning experiences that may ultimately lead to improved educational outcomes [6], [7], [8], [9], [10].

At the same time, the integration of AI into education brings several challenges, including concerns about validity and reliability, ethical issues, data privacy, and the potential for bias. Moreover, educators need to be trained in the effective use of AI tools. Research shows that students generally perceive AI technologies positively, recognizing their value in supporting learning activities. The potential of AI to transform educational practices by increasing accessibility, efficiency, and student engagement highlights its substantial impact on the development of the education sector [11], [12], [13].

We assume that implementing artificial intelligence (AI) in education technology can enhance learning outcomes. AI-generated multimodal content, such as text, images, video, and interactive elements, can improve learners' interaction with educational material. This study explores the benefits of integrating AI-generated multimodal content in the educational environment. The main goal is to analyze how learners interact with such content using advanced eye-tracking technology. The study is devoted to assessing the impact of AI-generated learning materials on students' cognitive interest, memory, and academic performance, as well as evaluating their effectiveness as a learning tool.

This study explores whether eye-tracking can help us understand whether AI-powered educational materials are effective or not.

We want to know:

1. The results of a quantitative test on students, using eye-tracking: research was done by monitoring of indicators such as how long students look at something, where they look, and what specific objects they look at, to understand how they react to materials when trying to learn.
2. Whether the eye-tracking test reflects how well the student actually understands and remembers what they have seen in educational materials by AI.
3. How do we know if a student is interested or not by looking at their eye movement?
4. How to analyze the results of the eye tracking to help create materials that are effective – and use AI as the tool to make the materials.
5. The results will be used to make an analysis for teachers and for the industry, so that teachers can understand how to best use AI-generated materials to improve students's learning.

Research Questions

1. What is the relationship between eye-tracking measures of interaction with AI-generated content and learners' comprehension and retention of the material?
2. Is eye-tracking appropriate for evaluating cognitive processes during learning experiences?
3. How do learners' responses to AI-generated content influence their learning experience?

The framework connects various elements contributing to students' academic achievement, including eye-tracking metrics, quizzes, surveys, educational materials, and AI-generated flowcharts, refer to Figure 1. These components influence reading comprehension, a crucial factor leading to academic success.

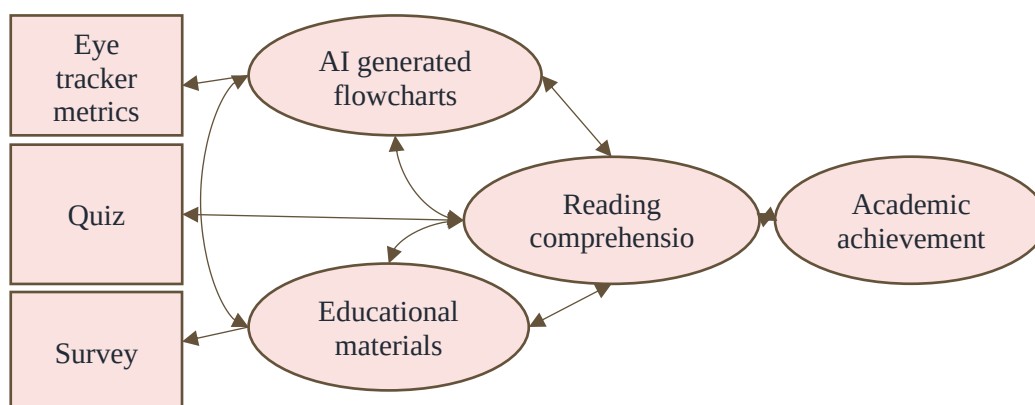


Figure – 1. **The Framework for Analyzing Learning Outcomes***

**compiled by the authors*

These visual materials illustrate the relationship between input data (such as eye-tracking metrics, tests, and surveys) and their impact on learning outcomes. Specifically:

- Eye-tracking metrics provide data on the distribution of interaction and attention with AI-generated content.
 - Tests assess the retention and application of knowledge as a measurable indicator of learning.
 - Surveys gather qualitative insights into students' experiences and perceptions.
 - AI-generated flowcharts and learning materials facilitate comprehension and support the development of reading comprehension skills, ultimately influencing academic performance.
1. Lower level (Remembering and Understanding)
 - For example, materials are created at the first level to remember and recall basic facts.
 - You could even find traditional text-based materials at this level. These help you understand and start to build a knowledge base about a topic.
 2. Intermediate level (Applying and Analyzing)
 - At this level, materials tend to be more complex, like AI-generated multimodal content such as flowcharts and diagrams. These can help you take theoretical knowledge and apply it in real world situations.
 - They also help you analyze information by finding relationships and patterns. This type of thinking helps you work on your critical thinking skills.

3. Higher level (Evaluating and Creating)

• Tasks at this level are usually quite complex and require you to draw on a bank of knowledge and to work on your own.

• Some AI-assisted tools help you to break down complex tasks and get to work on them. They also can help you foster the creativity and make thinking of the 21st century.

Introducing multimodal components at every cognitive level fosters a comprehensive strategy for skill-building. By weaving conventional resources with AI-generated materials, this approach serves a range of educational requirements while aiming to optimize student attention and academic results.

The study involved 30 undergraduate students who had completed at least one semester of economics, which provided them with a sufficient foundation to understand multimodal content.

Stimulus. Two articles were used in the study: “Mapping Your Competitive Position” by Richard A. D’Aveni, published on the Harvard Business Review website, et al. An AI-generated flowchart, created by ChatGPT 4.0, was included at the end of these articles to enhance comprehension and memorization. This integration of AI-generated visual aids exemplifies the practical application of AI in creating effective educational materials. Eye-tracking technology will quantify learners' attention to the content and its elements (text, diagram, and flowchart) and compare attention metrics. Metrics such as fixation durations, saccadic trajectories, and AOIs will analyze learners' attention allocation and cognitive processing patterns. The study aims to establish a clear link between attention and performance by correlating eye-tracking metrics with learning outcomes. This experiment is a 2 (Article Structure: AI-modified/non-modified) x 2 (Article) fractional within-subjects design. Participants will read two articles, one for each level of Article Structure.

The study has three parts. In Part 1, participants read Text 1 and answer related questions. In Part 2, participants read Text 2 and respond to associated questions. In Part 3, respondents give their experience feedback. Preliminary analysis combined an extensive analysis of eye-tracking data to determine attention patterns with multimodal content created with AI. Data was gathered on fixation times, saccadic movements, and areas of interest (AOIs) on AI-altered and unaltered edutainment materials.

Histograms of Attention Metrics (Figure 2): Histograms revealed distinct engagement patterns. For AI-modified content, the distribution of fixation durations was more uniform, suggesting consistent engagement across various content elements. In contrast, non-modified content exhibited a more variable distribution, with certain sections receiving disproportionately higher or lower attention. This finding indicates that AI-generated content may facilitate a more balanced distribution of cognitive resources.

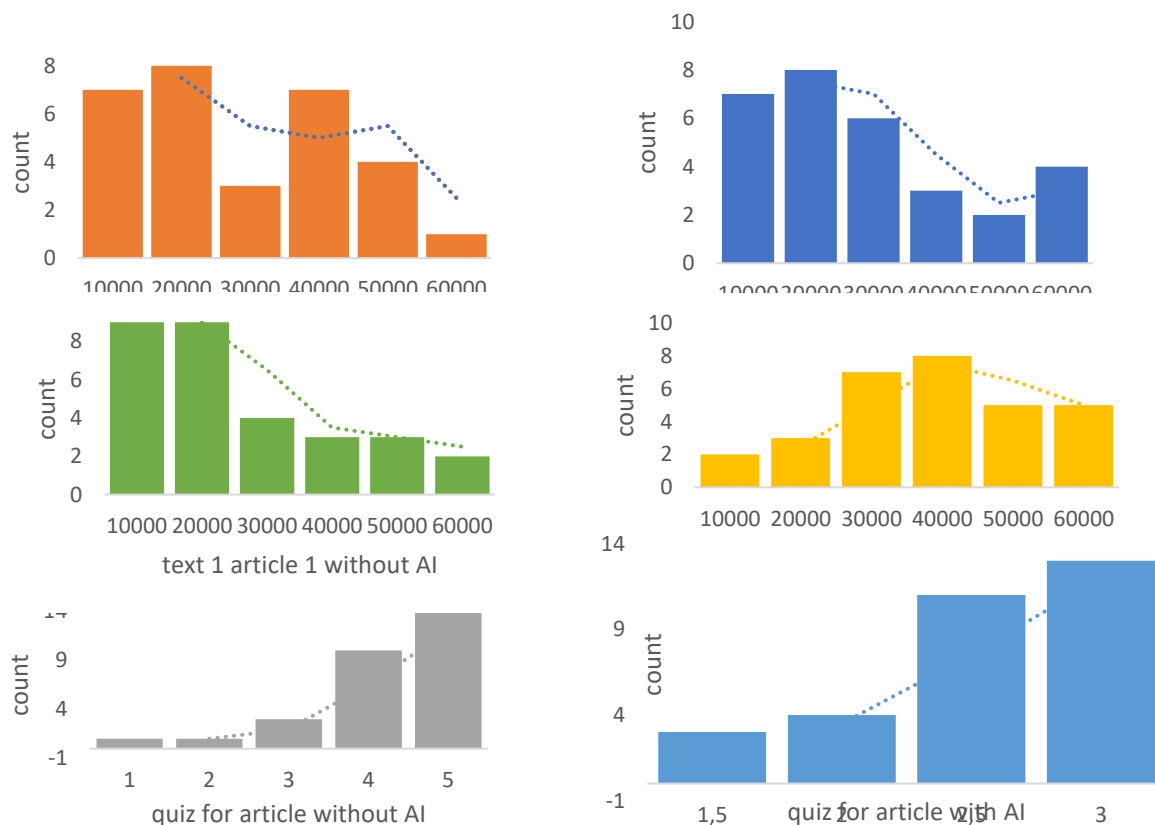


Figure – 2. **Attention indicators**

**compiled by the authors*

Correlation analysis (Figure 3): To quantitatively assess the relationships between eye-tracking metrics and learning outcomes (test scores), a correlation matrix was created.

AI_Article	1	-0,11	0,16	-0,05
Figure_Article	-0,11	1	0,38	-0,18
Text_Article	0,16	0,38	1	-0,19
Quiz_Score	-0,05	-0,18	-0,19	1
	AI_Article	Figure_Article	Text_Article	Quiz_Score

Figure – 3. **Correlation Analysis**

**compiled by the authors*

Here's what we found:

Looking Time: Those who looked longer at the AI images usually scored a bit higher on the test ($r = 0.45$, $p < 0.05$). So, taking your time to observe appeared to assist a person grasp things better.

Eye Movements: People whose eyes moved around fast tended to not do well on the test ($r = -0.38$, $p < 0.05$). Perhaps lots of erratic eye movement made it harder to understand, mainly with the usual content.

Focus Points: The AI-generated charts and pictures caught people's attention. Focusing on these was tied to better scores on questions about those parts ($r = 0.52$, $p < 0.01$).

We checked out where people looked most using heatmaps, which show eye movement hot spots. Heatmaps for AI-modified content demonstrated higher gaze concentration on key informational elements (e.g., AI-generated flowcharts), whereas non-modified content showed dispersed gaze patterns, indicating less focused attention.

Participants' feedback highlighted the intuitive appeal of AI-generated content. Many users reported that flowcharts and diagrams assist them in organizing and understanding complex information, which results in increased engagement and better retention.

This feedback supports the quantitative results, highlighting the possible advantages of AI-enhanced educational materials. A strong connection was found when comparing attention metrics with learning results. Participants who spent more time fixating and had shorter saccadic paths on AI-generated visuals consistently performed better on comprehension tests. This indicates that AI-created visual aids attract attention and promote deeper thinking, leading to improved information retention.

The fine-grained analysis of eye-tracking records provided an indication of cognitive processes while working with educational content. For instance, longer fixation duration on AI-diagrams implies deeper processing, which likely boosts comprehension and recall. However, a high frequency of saccadic movements within unaltered content indicates confusion or difficulty in identifying important information.

We used heatmaps to check out how people were looking at things and where their eyes were drawn. Looking closely at the eye-tracking data gave us a clue about what students were thinking when they were learning stuff. For example, if someone stared at an AI picture for a while, they were really trying to get it, which probably helped them understand and remember it better. But if their eyes darted all over the place when looking at regular stuff, they were likely puzzled or struggling to figure out what was important.

The numbers all checked out ($p < 0.05$), so we can trust the results. The bottom line is that AI-created content seems to make learning better by grabbing people's attention.

This study is a big deal for educational tech because it's the first one to show that AI content can really make learning better. The results give us ideas on how to make learning stuff that matches how students think, which could change how we teach.

In this study, we used eye-tracking to get a better handle on how people learn. It gives us proof showing that understanding and visual attention are linked, which helps build up thinking smarts and create smarter educational tools.

This article puts together educational technology, thinking smarts, and AI, which will hopefully get different fields working together. What we found is helpful for teachers, learning designers, AI users, and thinking smarts students, and it backs up teamwork to make teaching better.

The advice from this study can boost teaching by showing how AI content makes learning more interesting and understandable. This can make classrooms more interactive and tailored to each student, which means students will do better.

Conclusion. This research indicated the learning potential of multimodal AI-composed content to advance learning achievements, particularly comprehension and academic performance. We determined that AI-crafted diagrams and flowcharts had the potential to considerably enhance cognitive resource allocation and test scores. Eye-tracking data offered insightful information on student attention, with gaze behavior and academic attainment associations.

The originality of this study lies in the use of eye-tracking equipment to evaluate the effectiveness of AI-generated learning materials. The paper presents empirical data on their impact on cognitive processes. Practical recommendations include fine-tuning the design of multimodal instructional materials to enhance interactivity and personalize the learning environment.

This study's findings could help create AI learning tools that fit different learning styles. We need more research to see how AI resources affect different schools, age groups, and subjects over time, so we can use them better.

This study sets the stage for looking at the future effects of AI content and how it changes education. It stresses how important custom learning and emotions are, giving us a base for more studies.

This research has funded by the Science Committee of the Ministry of Education and Science of the Republic of Kazakhstan (Grant No. AP25796417 «Development of a model for student-AI interaction in the context of higher education digitalization»).

REFERENCES

1. Wladawsky-Berger I. The impact of artificial intelligence on the world economy // The wall street journal. – 2018. – №16. – 11 p.
2. Bughin J., Seong J., Manyika J., Chui M., Joshi R. Notes from the AI frontier: Modeling the impact of AI on the world economy // McKinsey Global Institute. – 2018. – №4(1). – P. 2–61.
3. Shoufan A. Exploring students' perceptions of ChatGPT: Thematic analysis and follow-up survey // IEEE access. – 2023. – №11. – P. 38805–38818. – DOI:10.1109/ACCESS.2023.3268224
4. Chen L., Chen P., Lin Z. Artificial intelligence in education: A review // IEEE access. – 2020. – №8. – P. 75264–75278. – DOI:10.1109/ACCESS.2020.2988510
5. Kurmanov N., Bakirbekova A., Adiyetova E., Satbayeva A., Rakhimbekova A., Nabiyeva M. ICTs' Impact on Energy Consumption and Economic Growth in the Countries of Central Asia: An Empirical Analysis // International Journal of Energy Economics and Policy. – 2025. – №15(3). – P. 8–16. – DOI:10.32479/ijeep.18779
6. Chassignol M., Khoroshavin A., Klimova A., Bilyatdinova A. Artificial Intelligence trends in education: a narrative overview // Procedia computer science. – 2018. – №136. – P. 16–24. – DOI:10.1016/j.procs.2018.08.233
7. Jensen J. A systematic literature review of the use of Semantic Web technologies in formal education // British Journal of Educational Technology. – 2019. – №50(2). – P. 505–517. – DOI:10.1111/bjet.12570
8. Kahraman M., Kuzu A. E-mentoring for professional development of pre-service teachers: A case study // Turkish online journal of distance education. – 2016. – №17(3). – DOI:10.17718/tojde.19973
9. Incio Chavesta J.E., Ramos Farroñán E.V., Arbulú Ballesteros M.A., Merino Núñez M., Mendoza Zuta J.C., Mendoza Zuta L.K., Flores Solis J.G., Reyes-Pérez M.D. Exploring the challenges of social and sustainable entrepreneurship strategy: A review of the literature // Corporate & Business Strategy Review. – 2025. – №6(1). – P. 349–360. – DOI:10.22495/cbsrv6i1siart11
10. Chen X., Xie H., Zou D., Hwang G.J. Application and theory gaps during the rise of artificial intelligence in education // Computers and Education: Artificial Intelligence. – 2020. – №1. – 100002 p. – DOI:10.1016/j.caeai.2020.100002
11. Tahiru F. AI in education: A systematic literature review // Journal of Cases on Information Technology (JCIT). – 2021. – №23(1). – P. 1–20. – DOI:10.4018/JCIT.2021010101
12. Crompton H., Burke D. Artificial intelligence in higher education: the state of the field // International journal of educational technology in higher education. – 2023. – №20(1). – 22 p. – DOI:10.1186/s41239-023-00392-8
13. Kasneci E., Seßler K., Küchemann S., Bannert M., Dementieva D., Fischer F., Kasneci G. ChatGPT for good? On opportunities and challenges of large language models for education // Learning and individual differences. – 2023. – №103. – 102274 p. – DOI:10.1016/j.lindif.2023.102274

REFERENCES

1. Wladawsky-Berger I. The impact of artificial intelligence on the world economy // The wall street journal. – 2018. – №16. – 11 p.
2. Bughin J., Seong J., Manyika J., Chui M., Joshi R. Notes from the AI frontier: Modeling the impact of AI on the world economy // McKinsey Global Institute. – 2018. – №4(1). – P. 2–61.
3. Shoufan A. Exploring students' perceptions of ChatGPT: Thematic analysis and follow-up survey // IEEE access. – 2023. – №11. – P. 38805–38818. – DOI:10.1109/ACCESS.2023.3268224
4. Chen L., Chen P., Lin Z. Artificial intelligence in education: A review // IEEE access. – 2020. – №8. – P. 75264–75278. – DOI:10.1109/ACCESS.2020.2988510
5. Kurmanov N., Bakirbekova A., Adiyetova E., Satbayeva A., Rakhimbekova A., Nabiyeva M. ICTs' Impact on Energy Consumption and Economic Growth in the Countries of Central Asia: An Empirical Analysis // International Journal of Energy Economics and Policy. – 2025. – №15(3). – P. 8–16. – DOI:10.32479/ijee.18779
6. Chassignol M., Khoroshavin A., Klimova A., Bilyatdinova A. Artificial Intelligence trends in education: a narrative overview // Procedia computer science. – 2018. – №136. – P. 16–24. – DOI:10.1016/j.procs.2018.08.233
7. Jensen J. A systematic literature review of the use of Semantic Web technologies in formal education // British Journal of Educational Technology. – 2019. – №50(2). – P. 505–517. – DOI:10.1111/bjet.12570
8. Kahraman M., Kuzu A. E-mentoring for professional development of pre-service teachers: A case study // Turkish online journal of distance education. – 2016. – №17(3). – DOI:10.17718/tojde.19973
9. Incio Chavesta J.E., Ramos Farroñán E.V., Arbulú Ballesteros M.A., Merino Núñez M., Mendoza Zuta J.C., Mendoza Zuta L.K., Flores Solis J.G., Reyes-Pérez M.D. Exploring the challenges of social and sustainable entrepreneurship strategy: A review of the literature // Corporate & Business Strategy Review. – 2025. – №6(1). – P. 349–360. – DOI:10.22495/cbsrv6i1siart11
10. Chen X., Xie H., Zou D., Hwang G.J. Application and theory gaps during the rise of artificial intelligence in education // Computers and Education: Artificial Intelligence. – 2020. – №1. – 100002 p. – DOI:10.1016/j.caeai.2020.100002
11. Tahiru F. AI in education: A systematic literature review // Journal of Cases on Information Technology (JCIT). – 2021. – №23(1). – P. 1–20. – DOI:10.4018/JCIT.2021010101
12. Crompton H., Burke D. Artificial intelligence in higher education: the state of the field // International journal of educational technology in higher education. – 2023. – №20(1). – 22 p. – DOI:10.1186/s41239-023-00392-8
13. Kasneci E., Seßler K., Küchemann S., Bannert M., Dementieva D., Fischer F., Kasneci G. ChatGPT for good? On opportunities and challenges of large language models for education // Learning and individual differences. – 2023. – №103. – 102274 p. – DOI:10.1016/j.lindif.2023.102274

Казыбаева А.М., Куттыбаева Н.Б., Райханова Г.А., Садыкова А.

ЖАСАНДЫ ИНТЕЛЛЕКТ АРҚЫЛЫ ЖАСАЛҒАН КОНТЕНТТІҢ БІЛІМ БЕРУ ЖӘНЕ ЭКОНОМИКАЛЫҚ ӨЛЕУЕТІН БАҒАЛАУ

Аңдатпа

Мақалада жасанды интеллект технологияларын қолдану арқылы жасалған мультимодальды мазмұнның білім беру және экономикалық маңызы қарастырылады. Мазмұнды пайдалану білім алушылардың білімді игеру сапасына ғана емес, сонымен қатар цифрлық білім беру экономикасында жаңа тәсілдерді қалыптастыруға да әсер ететіні анықталды. Зерттеу көз қозғалысын бақылау технологиясын қолдану арқылы жүзеге асырылғаны көрсетілді, бұл ЖИ-контентті қабылдау когнитивтік үдерістерін тереңірек талдауға мүмкіндік берді. 30 экономист студенттердің қатысуымен 2×2 эксперименттік дизайн жасанды интеллект көмегімен жасалған диаграммалар мен блок-схемалармен толықтырылған өзгертілген және өзгертілмеген материалдарды талдауға мүмкіндік бергені көрсетілген. Көзді бақылау көрсеткіштері (бекіту ұзақтығы, саккад траекториялары, қызығушылық аймақтары) талданды, бұл когнитивті қатысу заңдылықтарын анықтауға және аі мазмұнының тестілеу нәтижелеріне әсерін анықтауға мүмкіндік берді. Зерттеу нәтижелері жасанды интеллект көмегімен жасалған мультимодальды материалдар білім алушылардың танымдық ресурстарының біркелкі бөлінуін қамтамасыз ететінін және олардың оқу үлгерімін арттыратынын көрсетті. Көрнекі элементтердегі ұзақ фиксациялар тапсырмалардың сәттілігімен оң корреляцияланатыны анықталды ($r = 0,45$, $p < 0,05$), ал саккадтардың шамадан тыс ұзындығы оқу нәтижелерімен теріс байланысты ($r = -0,38$, $p < 0,05$). Жұмыстың ғылыми жаңалығы жасанды интеллектті қолданудың білім беру және экономикалық аспектілерін біріктіруде жатыр. Цифрлық технологияларды дамыту және оларды білім беру процесіне енгізу кадрларды даярлау тиімділігінің өсуіне, білім беру қызметтерінің жаңа модельдерін қалыптастыруға және білім экономикасының бәсекеге қабілеттілігін арттыруға ықпал ететіні көрсетілген. Зерттеудің практикалық маңыздылығы мультимодальды оқу материалдарының дизайнын оңтайландыру және олардың экономикалық тиімділігін арттыру бойынша ұсыныстар беру болып табылады.

Казыбаева А.М., Куттыбаева Н.Б., Райханова Г.А., Садыкова А.

ОЦЕНКА ОБРАЗОВАТЕЛЬНОГО И ЭКОНОМИЧЕСКОГО ПОТЕНЦИАЛА КОНТЕНТА, СОЗДАННОГО ИСКУССТВЕННЫМ ИНТЕЛЛЕКТОМ

Аннотация

В статье рассмотрено образовательное и экономическое значение мультимодального контента, созданного с применением технологий искусственного интеллекта. Исследование реализовано с применением технологии отслеживания взгляда, что позволило более глубоко проанализировать когнитивные процессы восприятия ИИ-контента. Определено, что использование контента влияет не только на качество усвоения знаний обучающимися, но и на формирование новых подходов в цифровой экономике образования.

Экспериментальный дизайн 2×2 с участием 30 студентов-экономистов позволил провести анализ модифицированных и немодифицированных материалов, дополненных диаграммами и блок-схемами, созданными при помощи искусственного интеллекта. Проанализированы метрики отслеживания взгляда (длительность фиксации, траектории саккад, зоны интереса), что дало возможность выявить закономерности когнитивной вовлеченности и определить влияние ИИ-контента на результаты тестирования.

Результаты исследования показали, что мультимодальные материалы, созданные с использованием искусственного интеллекта, обеспечивают более равномерное распределение когнитивных ресурсов обучающихся и повышают их академическую успеваемость. Выявлено, что длительные фиксации на визуальных элементах положительно коррелируют с успешностью выполнения заданий ($r = 0,45$, $p < 0,05$), тогда как чрезмерная длина саккад отрицательно связана с результатами обучения ($r = -0,38$, $p < 0,05$).

Научная новизна работы заключается в интеграции образовательных и экономических аспектов использования искусственного интеллекта. Показано, что развитие цифровых технологий и их внедрение в образовательный процесс способствуют росту эффективности подготовки кадров, формированию новых моделей образовательных услуг и повышению конкурентоспособности экономики знаний. Практическая значимость исследования заключается в предоставлении рекомендаций по оптимизации дизайна мультимодальных учебных материалов и повышению их экономической эффективности.

