

планируем расширить количество наборов Stem Logic Gates, доступных каждому учащемуся, и разработать более сложные задания и эксперименты с использованием большего количества логических блоков, также включить набор лабораторных упражнений, чтобы помочь учащимся изучить и понять теорию и практические аспекты цифровых логических элементов. Также планируется адаптировать данные наборы для учащихся общеобразовательных опорных школ, поделиться опытом и обучить учителей информатики сбору таких наборов у себя в школах.

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*Aida Adilzhan¹, Aisulu Baimanova², Arailym Bexultanova³,
Darina Seksembayeva⁴, Shynar Dumanbek⁴
^{1,2,3,4}SDU University, Kaskelen, Kazakhstan
e-mail: 200210020@stu.sdu.edu.kz*

IMPROVING SECONDARY SCHOOL STUDENT PERFORMANCE IN BIOLOGY CLASSES USING AI

Abstract. The implementation of Artificial Intelligence into teaching biology to secondary school students implies that it will help people learn better and achieve educational goals more effectively. This study focuses on assessing the impact of AI-driven teaching methods on student motivation and academic performance through qualitative interviews and quantitative surveys with biology teachers, and pre- and post-tests results of students from different schools of Almaty, Kazakhstan. The study found that while there was only a slight improvement in overall academic knowledge, student motivation

significantly increased as a result of the AI-enhanced learning experience. The incorporation of AI technologies stimulated student interest and enthusiasm for biology, fostering a deeper engagement with the subject matter and promoting active participation in learning activities. Overall, this study underscores the importance of integrating innovative technologies like AI into educational practices to create dynamic and engaging learning environments that inspire and empower students to excel in their academic pursuits.

Key words: Artificial Intelligence, AI, Biology, Innovative Teaching, Innovative Technolog

Introduction

The current rapid development of technology, the processes of globalization, and the transition to a digital society certainly concern the field of education. There has never been in history that new reforms, the development of culture and technology did not apprehend the education system. In such a vast world, everything is always interconnected, so new technologies have not bypassed the education system. In the 20th and 21st centuries, the use of innovative technologies entered the daily life of both teachers and students (Yeltunova, I., Nesterov, A., 2021). For example, in 1966, a professor at Stanford University conducted the first experiment on teaching school children through computers. Then various computer systems, programs and platforms began to develop. However, the breakthrough in the widespread use of electronic media in education was during the pandemic. The use of these technologies makes it possible to change the system of the educational process, improve the quality of education, motivate students and immerse them in the educational environment, but of course there are negative sides too. This work is interested in the application of information systems in the field of pedagogy, namely artificial intelligence. "Artificial intelligence" (AI) is a term that was introduced half a century ago, in a summer seminar at Dartmouth College (Hanover, USA) (Ganascia, J., 2018). Artificial intelligence is a field of science and technology that creates intelligent machines and computer programs to perform various tasks that require human intelligence (Bhbosale, S., Pujari, V., & Multani, Z., 2020). It is a system that simulates different functions that a human can perform. A lot of time has not passed with the use of AI in the field of education, but the expected results are promising. For example, facilitating student assessment, promoting personal learning, and completing learning processes online, mixed and offline. Due to the shortage of teachers in the United States, scientists have proposed an option to replace several teacher roles with robots with artificial intelligence (Edwards, B., Cheok, A., 2018). There is a special term "Artificial Intelligence in Education" (AIEd), which is one of the frequently discussed topics among scientists. At the moment, there is a small gap between studying the use of AI in education and its actual implementation in ordinary schools. In the spring of 2023, only 9% of American teachers used artificial intelligence tools, according to the consulting firm Tyton Partners. However, by the autumn of the same year, this figure had increased to 22% (Kelly, S., 2024).

Currently, Kazakhstan ranks 83rd out of 132 countries in the global innovation index. In the ranking of the readiness of states to implement artificial intelligence technologies in 2020, the country ranks 64th out of 172. As part of the digital transformation of public administration and the development of digital technologies, the Ministry of Digital Development, Innovation and Aerospace Industry is developing a concept for the development of artificial intelligence (Bigari, R., 2023).

Problem statement. As the use of AI in other spheres of life shows good results, it means that its use in the educational process can affect the academic performance of students, their motivation and interest in lessons at school. As it is written above, American teachers have already begun to introduce artificial

intelligence into their work, why not introduce this in Kazakhstan? Statistics show that the Republic of Kazakhstan is at the initial stage of AI application. The interest in the influence of AI in the field of education is very high, therefore, this study was charged, which may be an innovation in the education program in Kazakhstan. The correct use of AI can lead to unprecedented results. It became interesting whether it is possible to use AI in the educational process in ordinary schools of the country? Biology is one of the most interesting lessons in school. The integration of artificial intelligence can be much more successful than humanity can imagine. The introduction of AI into the teaching and perception of a biology course can yield significant results, both in the academic part and in improving the interest of students. The purpose of the study is to introduce artificial intelligence in a biology lesson, to understand whether AI affects academic performance and motivation of students.

Research questions. The study will be guided by the following research questions:

- How can AI be utilized to enhance the academic performance of secondary school students in biology classes?
- Is it effective to use AI in biology lessons to improve the students academic performance?
- Are schools in Kazakhstan familiar with using AI in teaching biology?

Hypothesis of the study:

- AI as a tool for enhancement of academic performance can be used for assessment and students' self-work.
- Using AI in biology lessons is effective in many ways.
- Using AI in education is new for most of the Kazakhstani schools.

This work presents the studied literature about artificial intelligence, its application in the educational system, pros and cons. The following parts analyze the methodology of the experiment, its analysis and discussion, concluding with a conclusion on the implementation of AI in biology lesson.

Literature review

AI definition. Nowadays it is difficult to imagine life without the confusion of any innovative systems. Whether it is the field of education, science, medicine, sports, art, etc. any field is connected with the latest digital technologies. Humanity is constantly coming up with something, developing it to improve the quality of life. One example is the emergence of the term artificial intelligence.

What is AI, and how has its existence changed anything on the positive side? Is he smarter than humans? No, says Jean-Gabriel Ganasia, a lecturer in computer science at the Sorbonne University, professor, as well as a researcher at the LIP6 research laboratory (Laboratoire d'Informatique de Paris 6), a full member of the European Association for Artificial Intelligence EurAI (European Association for Artificial Intelligence): this is just a myth inspired by science fiction. Next, we will consider the main stages of the development of this branch of science, the achievements of modern technology and ethical issues that increasingly require attention (Ganascia, J. (2018).

Artificial intelligence (AI) is a branch of science, the property of artificial intelligent systems to perform creative functions that are traditionally considered the prerogative of man (not to be confused with artificial consciousness); the science and technology of creating intelligent machines, especially intelligent computer programs. AI was officially born in 1956 at a summer seminar at Dartmouth College (Hanover, USA), which was organized by four American scientists: John McCarthy, Marvin Minsky, Nathaniel Rochester and Claude Shannon. Since then, the term "artificial intelligence", coined, most

likely, with the aim of attracting universal attention, has become so popular that today it is hardly possible to meet a person who has never heard it. Over time, this branch of computer science has developed more and more, and intelligent technologies in the last sixty years have played an important role in changing the face of the world (Ganascia, J. (2018). *The main components of AI*

Artificial intelligence is the result of the synergy of many technological, scientific and industrial achievements of the previous 100 years.

There are many factors that influenced the expansion of AI, but there are several key ones: computing power, Big data (including data analysis algorithms) and innovative machine learning algorithms, especially neural network methods.

One of the main drivers of the rapid development of AI was computer games and gamers, who drove the progress of video cards, which allowed exponentially increasing computing power, which later began to be used for AI projects.

The more data there is, the more accurate the results, so AI could not appear before sufficient computing power, Big Data and a high level of Internet development appeared, but all this needs to be interpreted and processed correctly, i.e. algorithms are needed (Head of Nvidia).

AI methods.

Data analysis

Data Science extracts knowledge, finds patterns in data, and predicts using methods of statistics, econometrics, deep learning, and machine learning.

Artificial Intelligence Training

Main article: Artificial Intelligence Training

Deep Learning AI. For 2023, the following methods are used: backpropagation, Generative Adversarial network (GAN), convolutional neural networks (CNN), recurrent neural networks (RNN), direct propagation networks (FNN), Deep neural networks (Deep Neural Networks) and autoencoders (Head of Nvidia).

Application

Many of the results achieved using AI technologies are superior to humans: in 1997, a computer defeated the then world chess champion, and recently, in 2016, other computers beat the world's best go and poker players. Computers prove or help prove mathematical theorems; knowledge is created automatically, based on machine learning methods and with the help of huge amounts of data, the volume of which is calculated in terabytes (10 to the 12th degree) and even in petabytes (10 to the 15th degree).

Self-learning intelligent systems are widely used in almost all fields, especially in industry, banking, insurance, healthcare and defense. Many routine processes can now be automated, which will transform our professions and eventually eliminate some of them (Head of Nvidia).

Ethical risks

AI does not only involve rational analysis and computer reproduction of most aspects of intelligence – perhaps only with the exception of humor. Machines significantly exceed our cognitive abilities in most areas, which makes us wary of some ethical risks. These are three types of risks: a shortage of work that will be performed by machines instead of people; consequences for human independence and, in particular, for his freedom and security; fears that more "smart" machines will dominate people and cause the death of mankind (Ganascia, J. (2018), (Saghiri et al., 2022).

However, upon closer examination, it becomes obvious that people's jobs are not disappearing, but are being transformed, requiring new skills. Similarly, the independence of the human person and his freedom are not in imminent danger due to the development of AI - provided, however, that we remain vigilant in the face of technology intrusion into privacy (Ganascia, J. (2018), (Saghiri et al., 2022).

And finally, contrary to some claims, machines do not pose an existential risk to humanity, since their autonomy is only technical in nature and in this sense does not correspond to the chains of material causality going from information to decision-making. In addition, machines are not morally independent, and therefore, even if they sometimes confuse and mislead us with their actions, they still do not have their own will and obey the goals that we set for them. (Saghiri et al., 2022).

AI in the education system. The advent of information and digital technologies in our lives simplified a lot of things, reducing the time to complete some tasks in different fields of professions. The development of ICT is improving every year, an example of this is the emergence of a new field in ICT - artificial intelligence. The emergence of AI has increased the effect of work performed in various areas of human life, including in the field of education. The use of AI has led to digital transformations that no one could ever have imagined.

One of the forms of artificial intelligence progress in the field of biology and biological education has led to exceeding expectations in the development of science in these two areas. The application of artificial intelligence in biology and education in biology has opened up new methods and discoveries that can be useful to humanity. Some studies have identified the potential of using artificial intelligence in biology and biology education. The study of various aspects of the literature has led to the identification of various ways to use artificial intelligence. In the field of biology, including the use of artificial intelligence, for the analysis of biological data, genetic research, the study of complex biological phenomena (such as synthetic biology and systems biology), bioinformatics, disease detection and diagnosis. The use of artificial intelligence in various fields of biological sciences, including medicine, agriculture, animal husbandry and industry, contributes to product development and production automation using the Internet of Things (Aripin et al., 2024).

The application of artificial intelligence in the field of education is mainly aimed at assisting in the learning process, creating an intelligent campus and introducing intelligent teaching, teaching and management methods. Image recognition, face analysis, adaptive learning, and other artificial intelligence innovations are being applied in education, initiating change and improving teacher performance (Kuo, 2020) and student learning experience. (Cui, Xue, & Thai, 2019). Moreover, combining artificial intelligence technology and extensive data allows for the collection and in-depth analysis of educational information, which can contribute to improving teaching and improving its quality (Williamson, 2018). Next, a review of the literature on the impact of artificial intelligence on adaptive learning, teacher evaluation, virtual classrooms, intelligent campuses and learning robots will be presented (Huang et al., 2021).

Adaptive learning.

Artificial intelligence contributes to the development of adaptive learning. This approach uses data mining, educational systems, and real-time analytics. The goal of adaptive learning is to integrate testing, learning, memorization and practice into a single system in order to improve the learning process of students (Van Der Vorst & Jelcic, 2019). An adaptive learning system is able to collect data on student behavior. (Goel & Polepeddi, 2016). Currently, many companies offer mature adaptive learning systems

such as DreamBox Learning (Grams, 2018), BYJU'S (Tripathy & Devarapalli, 2020) and IBM Watson Education (Russo-Spena, Mele and Marzullo, 2019). Teachers actively apply various techniques, including classroom systems, to improve the effectiveness of the educational process. One of these methods is ALEKS (Assessment and Learning in Knowledge Spaces), a web-based assessment and learning platform based on artificial intelligence (Huang et al., 2021).

Yilmaz's (2018) study looked at the impact of ALEKS on the academic performance of high school students in mathematics. The results of the study showed that the use of ALEKS has a positive effect on the success of students in mathematics at the end of the school year, according to statistics. However, in a meta-analysis conducted by Fang, Ren, Hu, and Graesser (2019) to evaluate the effectiveness of learning using ALEKS, it was found that ALEKS has the same beneficial effect, but does not exceed traditional classroom teaching, except in certain cases when ALEKS was used for shorter periods, rather than more long-term ones. This research will help teachers using the ALEKS learning system to better inform students about the learning process (Huang et al., 2021).

BYJU'S app is a popular program in India that uses artificial intelligence in teaching, just like ALEKS. BYJU includes online lectures, tasks for mastering topics. In addition, this program uses some animations to explain complex materials and for easy understanding by students. The game control interface allows you to make the learning mode interesting. And also, the BYJU system can offer courses according to the abilities of the students (Kulkarni, Rai, & Kale, 2020). Shruti and Mukherjee (2020) found that the BYJU application has led to changes in education in India by introducing constructive teaching and learning methods. The majority of respondents noted that the application is interactive, convenient and practical. BYJU can also promote deep conceptual understanding in students, and an analysis has been conducted in India on how BYJU promotes deep conceptual understanding (Casanova, 2018). However, the slightly high price may also prevent some students from using it (Huang et al., 2021).

Teaching evaluation.

Student assessment is one of the important parts in the learning process. Without checking and analyzing the results of students, it is difficult to move forward, because when evaluating students, the teacher will be able to understand how much the material has been assimilated, how much the students were able to understand the new topic. Teachers will have to devote a lot of their time and efforts to prepare questions, evaluate students' work, and analyze test papers. However, some AI technologies such as image recognition, forecasting system, computer vision make assessment methods more diverse, the assessment process and the assessment results more accurate (Aripin et al., 2024), (Huang et al., 2021).

Artificial intelligence technology can not only create exam questions (Rahim, Aziz, Rauf and Shamsudin, 2018), but also automatically adjust assignments and test papers (Lee et al.) Correcting homework and tests is a tedious task for teachers. The time cost of correcting home tasks and controlling work leads to the fact that students are tired. Therefore, at the same time, when correcting control papers, errors can occur. Image recognition technology frees teachers from the hard work of correcting homework marks (Li, Cao, & Lu, 2017) and has a low error rate. Artificial intelligence technology is used to correct exam papers and allows you to detect blank or seemingly identical sheets, which saves the teacher time (Koć-Januchta et al., 2020).

Lytek and New Oriental have jointly launched the RealSkill program, which enhances the effectiveness of learning IELTS and TOEFL thanks to intellectual correction and oral practice. Students

can study IELTS and TOEFL using the RealSkill online platform, where the system can perform intellectual assessment, text correction, behavior analysis, intensive lectures, essay writing and study notes to improve exam preparation (Deloitte, 2019). The American Educational Testing Service (ETS) has developed and launched the E-rater (Chen, Fife, Bejar, & Rupp, 2016), a tool for automated assessment of student essays. The e-rater allows you to evaluate the students of the subject structure, grammar, general vocabulary and other aspects and other aspects of the essay, which not only increases the effectiveness of the evaluators' assessments, but also helps students improve their writing skills. ETS also uses artificial intelligence technology to evaluate spoken English and has developed the SpeechRater engine to help users excel in evaluating spoken English. (Chen et al., 2018), (Huang et al., 2021).

Virtual Classroom

Advances in virtual reality (VR), augmented reality (AR), hearing and perception technologies contribute to changing the educational environment. Ubiquitous information technologies are used to combine physical and virtual space, create virtual classrooms and virtual laboratories (Encalada & Sequera, 2017; Krumm, 2018).

In virtual classrooms, educational situations that are difficult to explain can be simulated using virtual technologies, while natural events and changes that are impossible or difficult to observe in real life can be represented in intelligent classrooms, creating a learning environment adapted to the conditions of students. By presenting educational content in a multidimensional way and mobilizing students' visual, auditory, kinesthetic and other senses for engagement, it can give students a keen sense of reality to help them understand the basic concepts and theories more intuitively and visually, increase students' interest in learning and improve learning efficiency. Hybrid virtual classrooms are a very promising opportunity for course flexibility, as students can come to campus or attend classes at home (Lakhal, Bateman and Bedar, 2017) ((Aripin et al., 2024).), (Huang et al., 2021).

Virtual Simulation Laboratories are virtual recreations of real experimental scenes through 3D modeling using multimedia, simulation and virtual reality technologies that create a working environment for the appropriate software and hardware on a computer, help manage all the connections of traditional experiments or can partially or completely replace them (Wang, Wu, Wang, Chi, & Wang, 2018). By creating highly simulated virtual experimental environments and objects for experimental manipulation, as well as using advanced somatosensory interactive devices for interaction in virtual reality, experimenters can perform various experimental projects as if they were conducted in a real environment (Xu, Ye, Lv, Wu & Gu, 2017). They have no information about damage due to experimental manipulation errors or skipping classical experiments due to experimental conditions. The experimental results obtained turned out to be better than those obtained in a real environment. Virtual experiments are based on a virtual experimental environment (simulation platform) that focuses on the interaction between experimental manipulation and simulation of experimental results (Liu, Valdiviezo-Diaz, Riofrio, Sun and Barba, 2015). Biology (Dirberg, Treusch and Wiegand, 2017), physics (Gunawan, Nisrina, Suranti, Kherayanti and Rahmatia, 2018), chemistry (Herga, Kagan and Dinevski, 2016) and other subjects (Chong and Koh, 2018) can be conducted in a virtual laboratory. The interactive work of the Virtual Modeling Laboratory helps to develop students' practical skills. At the same time, the virtual laboratory equipment allows you to save resources and avoid experimental risks (Orobor & Orobor 2020; Rocca, Rosa, Sassanelli, Fumagalli and Terzi 2020). However, according to Makransky, Terkildsen and

Mayer (2019), scientific learning in virtual reality, despite its motivational properties, can lead to cognitive overload and distraction of students, which can reduce learning outcomes (Huang et al., 2021). Opportunities for using AI in education.

The introduction of AI into the biology teaching process in secondary schools affects their academic performance. If the use of AI would not have any positive result in the learning process, then there would be no point in implementing it. And so, what are the advantages of using AI?

Opportunities for Learners

Traditional teaching sometimes puts students at a disadvantage due to inefficient time spent searching for information, checking facts, or simply learning concepts that are not presented effectively. Chatbots such as “GPT Chat powerful big language model developed by open AI” can significantly reduce learning time by tens or even hundreds of hours with endless access to information (Rahman & Watanobe, 2023).

Perhaps many people have come across the fact that you spend too much time and effort searching for information on a certain topic on Google. If you ask a chatbot, create a step-by-step explanation of this concept in simple words. He will create a step-by-step diagram and explain to you everything you want to know.

Imagine how much easier learning can be when you use GPT chat to present information in ready-made diagrams, without wasting time searching for all the information yourself.

GPT chat can be used as a virtual tutor. For example, you can ask the GPT chat to ask questions about how dopamine works one question at a time. Regardless of whether the answer is correct, it provides an explanation (Rahman & Watanobe, 2023).

This method is effective because it really challenges you to reproduce the information you have just learned, thereby strengthening the connections between your brain and new information.

To use this feature, you can try this hint. You're a biology teacher. Create 10 questions with a choice of answer on the topic of, for example, cellular respiration. There should be one correct answer and three incorrect ones. Let me answer one question at a time before providing the next question. After each of my answers, tell me if it is correct and provide an explanation accordingly. You can also add the query "rate my grade as a percentage".

As a result, bot gives an explanation of the mistakes that were made, as well as evaluates knowledge and suggests what else needs to be learned (Rahman & Watanobe, 2023).

Explanation of scientific terms. The GPT chat can provide analogies to better understand any misunderstandings or questions that students may have. Students can continue to ask any GPT Chat questions until they have mastered the concept or idea well enough.

Opportunities for Teachers

In addition to explaining a new topic to students, to prepare materials for the lesson, teachers have to make up tasks and homework on the topics covered, check the answers of each student, give a grade and sometimes organize extracurricular activities on various topics. Such types of efforts can reduce the effectiveness of preparing the basic material and reduce the time of teacher-student interaction, which is an important part of the learning process. Another value of artificial intelligence in education is that it can reduce the burden on teachers and make them more focused on humanistic care. Below are some examples of using AI to improve the effectiveness of teaching for teachers (Nasution, N. 2023).

1) Lesson planning. There are several types of AI such as “chat GPT”, “lesson plans.ai”, “copilot”, “eduaide.com” to prepare each lesson plan. These AI tools allow you to provide illustrations, event ideas, and exercises on specific topics that will help teachers better educate their students. Example using an AI to create a lesson plan (eduaide.com) (Nasution, N., 2023).

“Unit: Cellular Respiration

Grade Level: Underclass (Students Grade 9-10)

Lesson Duration: 45-52 minutes

Instructional Model: 5E Model (Engage, Explore, Explain, Elaborate, Evaluate)

Lesson Outline:

Engage (5 minutes):

- Begin the lesson by asking students to brainstorm and share what they know about energy and how our bodies obtain it.
- Show a short video clip or image related to cellular respiration to pique students' interest and activate prior knowledge.

Explore (10 minutes):

- Divide students into pairs or small groups.
- Provide each group with a set of materials, including a respirometer, test tubes, pipettes, and a small amount of yeast (used as a cellular model).
- Instruct students to design an experiment to investigate the relationship between temperature and the rate of cellular respiration in yeast.
- Encourage students to think critically about the variables they need to control and the data they should collect.

Explain (15 minutes):

- Facilitate a whole-class discussion to share and analyze the results of the experiment.
- Introduce the concept of cellular respiration and its importance in producing energy for cells.
- Explain the different stages of cellular respiration, including glycolysis, the Krebs cycle, and the electron transport chain.
- Use visual aids and real-life examples to help students understand the processes involved.

Elaborate (10 minutes):

- Assign students a task where they have to create a concept map or a flowchart to depict the different stages of cellular respiration.
- Encourage students to include key vocabulary, main processes, and the products of each stage.
- Provide additional resources (books, websites, etc.) for students who need more information or want to explore further.

Evaluate (10-12 minutes):

- Distribute a worksheet or an online quiz to assess students' understanding of cellular respiration.
- The assessment should include questions that require students to apply their knowledge, such as explaining the differences between aerobic and anaerobic respiration or identifying the main products of glycolysis.
- Provide feedback and discuss the answers as a class to address any misconceptions.

Closure (5 minutes):

- Summarize the main points of the lesson, emphasizing the importance of cellular respiration in providing energy for our bodies.
- Ask students to reflect on what they have learned and how it connects to their prior knowledge of energy.
- Encourage students to ask any remaining questions or seek clarification on any concepts they find challenging.

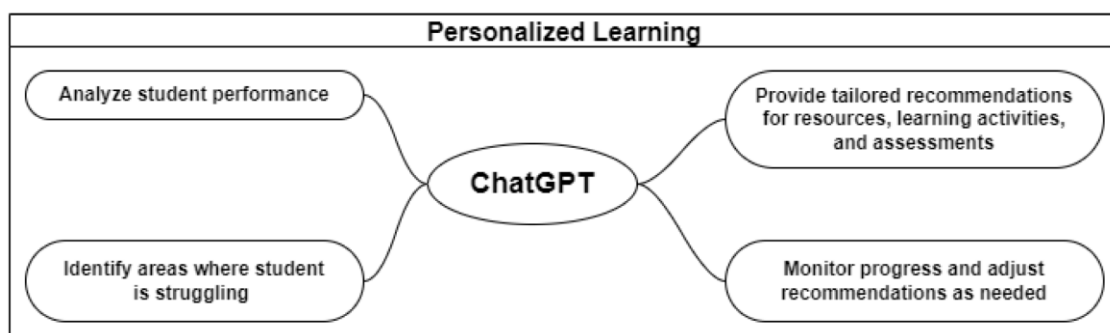
Options for Differentiation:

- Provide additional resources or reading materials for students who need extra support or want to delve deeper into the topic.
- Adapt the experiment for students with different learning needs, such as providing step-by-step instructions or modifying the data collection process.
- Offer alternative assessment options, such as a verbal presentation or a hands-on demonstration, for students who may struggle with written assessments.

Assessment of Learning:

- The worksheet or online quiz provided during the evaluation stage will serve as the assessment of student learning.
- Additionally, informal assessment can be done throughout the lesson through observation and class discussion to gauge students' understanding and engagement.”

2) Personalized Learning Support: Teachers can use ChatGPT to provide personalized learning support for students. ChatGPT can offer customized resources and training activities. For example, teachers can use ChatGPT to analyze student performance data and identify areas where students have difficulty with certain concepts or algorithms (Rahman & Watanobe, 2023).



example using chat GPT for personalized learning

3) Task creation. Assignments on the topics covered, home lessons have an important role in the learning process, since with the help of tasks, students can consolidate the material they have passed, teachers can observe how much the topic was clear to the students, how much the material was studied enough. Creating tests, tasks, and other materials is the teacher's responsibility. And sometimes the teacher tends to make mistakes when creating tests and answer options for them. AI for creating tasks will help teachers improve the quality of teaching. Some studies have shown that 79% (out of 272 students) of the students indicated that the questions generated by AI were relevant to the subject of the lesson. 72% of the students reported that the clarity of the AI-generated questions was acceptable. 73% of the students reported that

the accuracy of the AI-generated questions was good. Based on the results of the study, 20 of the 21 questions generated by Chat GPT AI were correct and accurate. AI such as quizbot, twee. com, conker, chat GPT are an example for creating questions, tests for lessons (Nasution, N. 2023).

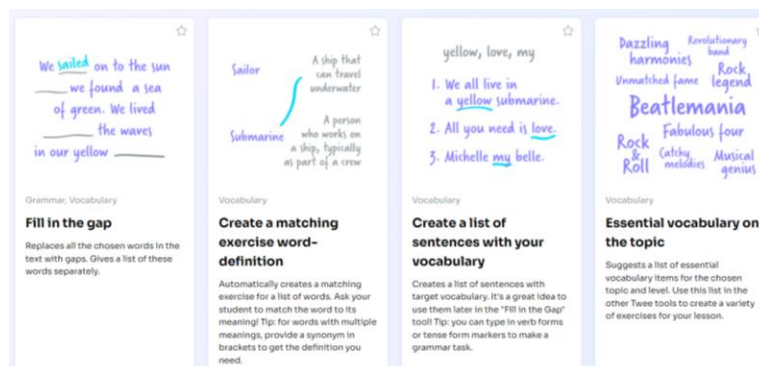


Figure 1. Example of using AI (twee.com) for task generation.

4) Grading and assessment. Evaluating completed work takes a lot of time, effort from teachers and is also a very monotonous job. Some AI such as “Gradescope” saves many teachers' time and improves work efficiency. Grade scope is an artificial intelligence-based grading tool that has been gaining popularity among teachers lately. It is designed to make the assessment of papers, assignments and exams more efficient and easier. The best part is that Gradescope is able to support grading across a wide range of subjects and levels in the natural sciences and humanities. Gradescope has a built-in plagiarism check feature that helps teachers identify unoriginal work without leaving the platform. In addition, Grade scope provides detailed analytics that allows teachers to identify areas for improvement. Grade scope helps you easily manage all your grades, whether online or in class. Save time on grading and get a clear picture of how your students are doing (ClassPoint, 2024).

Challenges of using AI in education.

Every novelty that has entered our lives has a number of drawbacks and negative sides. As mentioned above, the introduction of artificial intelligence into the educational process has a rather positive effect, since AI in education increases the effectiveness of teachers' work, helps students study the material at a sufficient level, reduces time for monotonous tasks of teachers, etc. However, despite what AI is capable of, a person using it may face difficulties, threats and have difficulties with AI. Next, let's look at the difficulties and negative aspects of implementing AI in education.

Ensuring inclusiveness and equality in the use of artificial intelligence in education.

As mentioned above, AI can provide many opportunities in the learning process. However, it can lead to a deepening of existing inequality and division, as the population who are disadvantaged will be excluded from AI-based education.

The result is a new kind of digital divide: the gap in the use of data-based knowledge to justify smart decision-making (Hilbert, 2015).

Equality and inclusivity are core values in the development of artificial intelligence policy in education. Thus, policy makers should ask several questions about implementation and equity when developing their policies. For example, what infrastructural conditions are relevant in developing countries to make possible the use of artificial intelligence in education? What have we learned from previous experience to create sustainable and fair conditions for the realization of digital rights in terms

of Internet access? How can artificial intelligence improve the effectiveness of education provided to disadvantaged groups? How can digital education and artificial intelligence develop much faster in developing countries to reduce the educational gap between the world's rich and poor students? What are the best practices in artificial intelligence for women and girls to reduce gender inequality (UNESCO,2019)?

Recent research has identified obstacles to the introduction of artificial intelligence into education in developing countries. The main ones include 1) availability of ICT hardware, 2) availability of electricity, 3) Reliability of the Internet, 4-) Cost of data transmission, 5) Basic ICT skills of students, 6) Language and 7) Lack of culturally appropriate content (NYE, 2015). Further reviews of the implementation of big data in developing countries show that the lack of basic infrastructure creates a new digital challenge in using data-based knowledge to make informed intelligent decisions (Hilbert, 2015). To eliminate these obstacles, many strategies need to be developed. It is important to start by defining the Internet as a human right and building numerous international alliances to build infrastructure in the poorest sectors of the developing world (Mutoni, 2017) (UNESCO,2019).

The work carried out by the United Nations Broadband Commission is one clear example of this.

The complexity of evaluating responses and texts generated by a chatbot: Like LLM with artificial intelligence, chatbots such as ChatGPT use complex algorithms and statistical models to produce responses and text based on templates extracted from large amounts of text data. The answers and texts generated by Chat GPT become the same as the answer and text that the person generated. This creates a problem for teachers and researchers. It is becoming increasingly difficult for existing plagiarism detection tools to distinguish between texts created by artificial intelligence and humans. As a result, restrictions were imposed on the use of Chat GPT in educational institutions. Cotton et al. introduced several text recognition strategies from LLMS such as Chat GPT, including language inconsistencies, lack of proper citations, factual errors, ambiguity, and poor understanding of context. Further research is needed to develop new technologies (for example, plagiarism detectors based on artificial intelligence) to ensure the integrity of education and scientific research (Rahman & Watanobe, 2023).

Ethical aspects and possible biases: It is necessary to carefully analyze the ethical consequences and biases associated with the use of Chat GPT in education and research. In most cases, LLMs are highly dependent on training data, and if this data contains bias or anomalies, it can lead to unfair results. For example, if the training data contains bias against certain groups of people or cultures, the model may generate unfair or discriminatory conclusions. Therefore, it is essential to ensure the diversity and balance of training data. Systems such as ChatGPT and other artificial intelligence language models can be used to create false news, incite hatred and other malicious content. This can lead to social upheaval, reputation damage, and even physical harm. In addition, internal mechanisms and processes are not transparent enough for users regarding their functioning. It is also important to ensure that the decision-making processes in these models are transparent to users. Since ChatGPT automatically generates responses without human intervention, it is difficult to determine responsibility for the created content. This makes it more difficult to address ethical issues and bias issues. Generative models such as ChatGPT may require the collection and processing of personal data, which raises concerns about the

confidentiality and security of information. Appropriate measures must be taken to protect personal data from unauthorized access (Rahman & Watanobe, 2023).

Critical thinking and problem solving skills: Simply getting answers from ChatGPT can be an obstacle to developing students' critical thinking and problem-solving skills. Since the Chat GPT can provide almost accurate answers to technical questions from a wide range of topics and correct or partially correct program code based on descriptions of problems, algorithms and task names, etc. As far as we know, there are no such tools that can recognize the code generated by artificial intelligence models, and thus the decision codes generated by artificial intelligence models can be used for academic programming exams and competitions. This poses the problem for educators of how to deal with this new situation (Rahman & Watanobe, 2023), (Huang et al., 2021).

However, there are strategies for determining whether ChatGPT responses and program codes are created. It is important to pay attention to the following features: ChatGPT responses usually do not contain personalization and are general in nature. In addition, program code usually includes syntax and formatting. Consistency checking is also important: ChatGPT responses may lack consistency or logical construction, especially in the case of complex queries. If the answers seem incoherent or meaningless, it may indicate that they were created by ChatGPT or another artificial intelligence model. By comparing the answers created by ChatGPT with the answers created by other language models or real people, we can determine their origin. If the response matches the responses generated by ChatGPT, this may indicate its automatic origin. Using Plagiarism Detection tools: We can also use plagiarism detection tools to determine if the response contains program code copied from somewhere else. This can help identify cases of fraud. In addition, if fraud with program codes is possible, we can ask additional questions to determine the depth of students' understanding of the answer to the question (Huang et al., 2021), (Rahman & Watanobe, 2023).

Methodology

Collecting data

The methodology to collect data in this research work is based on quantitative and qualitative research methods. First, as a quantitative research method, there was a survey questionnaire for students to collect information about their familiarity with AI tools and their expectations from this research as participants:

Questionnaire

1. *Your gender?* Female or Male
2. *Your age?* 12-13; 14-15; 16-17; 18
3. *Your grade?* 7,8,9,10,11
4. *Your school?* Alkiz, BIL, SDL, Kursant, Dostyk
5. *How familiar are you with the concept of Artificial intelligence (AI)?* Very familiar; Somewhat familiar; Not familiar
6. *Do you know the difference between AI powered tools and traditional applications?* Yes; No
7. *Do you use AI powered tools or applications as part of your educational activities?* Yes, frequently; Yes, occasionally; No, never
8. *If you have used any AI tool, what kind of AI tool was it?* ChatGPT; Grammarly; Quizlet; Kahoot; Educaplay; Bloocket; Quizizz; Photomath; Canva; Tome.app

9. *For what purpose did you use an AI tool?* To create a presentation; To write an essay; To create questions; To generate pictures; Not for learning
10. *Do you want to use AI in your studying process?* Yes, Maybe, No
11. *At what exact stage of the learning process would you like AI to help you?* To do homework; To solve mathematical problems; To explain topic with simple language
12. *Are you concerned about potential drawbacks associated with the integration of AI in education, such as privacy issues or biased algorithms?* Very concerned; Somewhat concerned; Not concerned at all
13. *What are the potential drawbacks or risks associated with the integration of AI in education in your opinion?* (Open question)

As a qualitative research method, interviews were taken from teachers, also about familiarity and usage, if it is used what kind of AI powered tools exactly they have used till that day:

Interview

- 1-How familiar are you with the concept of AI in the context of education?
- 2-Have you actively used any AI tools or applications in your biology lesson? If yes, please provide examples.
- 2a- In what purposes did/do you use AI tools?
- 3-What challenges and opportunities do you see in incorporating AI into biology teaching?
- 4-Have you observed any changes in student engagement or interest in biology as a result of incorporating AI into your lessons?
- 5-In your opinion, how important is AI in enhancing the learning experience for biology students?
- 6-Are there any concerns or reservations you have about the use of AI in biology education, such as ethical considerations or potential drawbacks?
- 7-To what extent do you see AI being integrated into biology education in the future?

Methods

The general starting point was a test that was taken to determine the average current score in order to compare the starting and final result at the end after the experiment. Most valuable criteria of chosen tools were reliability of tools in explaining the content. Mostly it was a quiz creating strategies by using AI powered tools. For example: using game apps/sites such as joyteka, blookey, kahoot etc to create entertaining quizzes but integrating only AI ChatGPT generated questions or using separate apps that create quizzes and questions by itself using a certain AI tool such as educaplay.

Method 1

Experiment: 8A and 8b. They were given different tasks to accomplish

Observant: 8C. Was taught using traditional methods.

Topic was Reproduction.

Pre-test is a mini quiz that they wrote after passing the topics taught in traditional ways.

Methods: mainly for assessment and during the lesson.

1-Creating anki-flashcards using AI to repeat the past topic. [homework]

2-Using ChatGPT as a search engine during the lesson activity:

Students write the questions they got during the lesson (passing new topic) on 3 question papers (each for each row). Then collect the papers and we together search for the answers using ChatGPT. Then

each student is asked with the questions he wrote and he had to answer using the gained knowledge. [classwork]

3-Generating questions for kahoot and educaplay using AI. [classwork]

4-Generating images using AI (Kandinskiy telegram bot). At first students were given to write an essay on "What will the world without mitosis look like?". The next lesson they were asked to generate an image of what it would look like without mitosis. [Homework]

5-Voicing the video using AI. Students were given to write a song on "Ear structure" using AI or voice videos from youtube. Some students voiced the song-video about ear structure with the voices of famous people using AI.

Method 2

10 "B" grade

15 students, the topic was cell, cell structure.

1. Pre test to check their previous knowledge. Introducing students with different types of AI
2. Students write any questions about topic on paper, then we ask this question from chat gpt
3. Divide them into 4 groups by 3-4 students, and for homework give them task to prepare presentations for given topic. Students use Chat GPT as a source of information, tome and Gemini to make a presentation, Copilot to generate pictures. Then they defend it to other students.
5. By using Chat GPT I generate games related to our topic. They play this game in groups. Post test to compare with pre tests

Method 3

9 "A" grade

20 students, Introduction to Genetics Chapter.

1. Taking a pre test by summative assessment 1.
2. Explaining the base of a topic.
3. Using a ChatGPT to create mini questions about topic 3-5 differently created but related questions every lesson.
4. Every week one hour of a formative assessment as an AI generated quiz about past two topics, approximately 20-30 questions using bloom taxonomy method (when there are used all levels of reaching the topic: remembering understanding, applying, analyzing, evaluating and creating). That continued probably 1-1/2 months.
5. Taking the post test as a summative assessment 2.

Ethical considerations

Through a process of this research ethical considerations were included. First off, all marks are not personally identifiable information, all grades are named with a letter randomly. We used all data privacy to prevent potential biases and measures were taken to anonymize and secure all data.

In summary, the methods of this study are all based on making questionnaires or answering questions by ChatGPT AI powered tools. And for collecting data there were quantitative and qualitative methods of research.

Analysis and findings

This part presents the analysis of gathered data and the findings on using AI in biology lessons.

Survey results

At the beginning of the experiment we conducted a survey among students from 5 different schools.

121 students participated in the survey.

Grade	7	8	9	10	11
Students number	8	35	17	15	46

Table 1. Results from the survey to question: Your grade?

To the question: “How familiar are you with the concept of Artificial intelligence (AI)?” the majority (71%) of respondents answered that they are “Somewhat familiar” with AI. 20, 7% of them answered “Very Familiar”, 8,3% of students answered “Not Familiar” with AI. To the question: Do you know the difference between AI powered tools and traditional applications? 52,1 % of the respondents answered “Yes”, 47,9% answered “No”. According to results, 70,2% of respondents use AI tools or applications “Occasionally” as part of their educational activities. Only 13,2% use “Frequently” and 16,5% of the respondents “Never” use AI tools or applications in their educational activities.

The most often used AI tools by respondents are Kahoot (80,7%), Quizizz (81%), ChatGPT (54,5%), Quizlet (47,1%), Photomath(45,5%), Canva(40,5%).

51,2% of respondents use AI tools to create a presentation, 31,4% to write an essay, 38,8% to create questions, 7,4% to generate pictures, 18,2% use AI tools not for study. To the question: Do you want to use AI in your studying process? 52,1% answered “Maybe”, 38,8% answered “Yes”, 9,1% answered “No”

Pre- and post-test results

This part provides information on the Pre test, which was conducted at the beginning of the experiment and the Post test, which was conducted at the end of the experiment.

Dostyq school		Kursant school		Almaty High School for Girls		Suleyman Demirel Lyceum	
Pre test	Post test	Pre test	Post test	Pre test	Post test	Pre test	Post test
65,8%	62,12%	68%	68,75%	63,65%	72,5%	52,55%	69,25%

Table 2: Pre and post tests of students

The Data from Figure ____ shows varying degrees of improvement in post-test scores across the 4 different schools. The experiment at “Dostyq school” was carried out among 11 grade students, at “Kursant school” among 10 grade students, at “Almaty High School for Girls” among 9 grade students and at “Suleyman Demirel Lyceum” among 8 grade students.

Students from “Almaty High School for Girls” and “Suleyman Demirel Lyceum” exhibited a notable increase in their post test scores compared to their pre test scores. “Kursant school” shows minimal change in post test scores compared pre test scores. “Dostyq school” experienced decreases in post test scores compared to pre test scores.

Interview

The interview was conducted with biology teacher of “Dostyq school” (Biology teacher 1) and with biology teacher of “Suleyman Demirel Lyceum”(Biology teacher 2).

To question: How familiar are you with the concept of Artificial Intelligence (AI) in the context of education? Biology teacher 1 answered that he is not familiar with AI in the context of education. Biology teacher 2 answered that she is familiar with AI.

To question: Have you actively used any AI tools or applications in your biology lessons? If yes, please provide examples. Bio1 answered that he uses AI very rarely in educational process, rarely uses the ChatGPT to look for answers to questions that he did not find, and uses “Monica” to generate pictures. Biology teacher 2 uses AI for generating lesson plans and modeling of her lessons, mostly using Chat GPT.

About the importance of using AI in the educational process, Biology teacher 1 answered that AI Should only assist students in the learning process, students can use AI to find out information and maybe generate pictures. Biology teacher 2 answers that AI can help students to achieve some learning goals. They can use AI in virtual labs, classification, provide scientific research and AI can help to find information easily.

To question: What challenges and opportunities do you see in incorporating AI into biology education?

Biology teacher 2 answered that students can face challenges in communication and socialization. Biology teacher 1 thinks that students can stop looking for information on their own from other sources like books.

Discussion

The aim of the paper was to analyze the effectiveness of Artificial Intelligence in improving secondary school students’ academic performance in biology lessons using qualitative and quantitative methods. The results clearly showed that artificial intelligence minorly contributed to the enhancement of students’ academic performance.

This section discusses and interprets the obtained results, as well as compares them to the already mentioned researches in the literature review.

5.1-The methods of AI usage for enhancement of students’ academic performance

The results of the pre- and post-test examinations showed that using AI for assessment and homework completion were the best ways to improve the academic performance of the students. Increase of 8% and 16% of the students’ performance in the test identifies that the methods they used to acquire the topic was effective. They were taught mostly by using chat bots such as ChatGPT. Students had to find the answers to their numerous questions using the chat bot. Furthermore, homeworks that students mostly avoid to do was given in a more creative and funny way using AI. For example, create flashcards using AI instead of just reading the topic; voicing the video related to the topic with the voices of famous people; generating images on the questions that make you think, such as “What world would look like without mitosis?”. These methods not only engaged students but also made their study different and attractive.

Another aspect that was modified by using AI was assessment. Quizzes for formative and summative assessments were done by the help of artificial intelligence tools. This process definitely made teachers’ work easier. Teachers that do not spend their time on creating and checking the quizzes,

can spend it on preparation of effective activities for the class. Such a teacher can make more students learn as he or she will spend the energy in that way.

5.2-Effectiveness of using AI to improve students academic performance

Students from 4 different schools showed different outcomes. Overall, two of the schools participating in the experiment showed a significant increase in the lesson achievements. This can be due to the different factors. One of them is that schools of “Bilim-Innovation” are known to use modern techniques and methods in teaching to develop 21st century skills of students. Therefore, using AI during the lessons, such as ChatGPT, showed a significant effect on students. The other two schools are focused on preparing students for the UNT (Unified National Test). Using AI in these schools didn’t show much effectiveness. This pattern can be seen because of the different methods of teaching and objectives of the lessons that teachers have. Students in such schools are mainly focused on learning the theory by heart and not to develop modern skills or understanding of the new technologies. Adapting AI tools for teaching was complicated.

5.3-According to the interview with teachers it can be stated that most schools are familiar with using AI in their lessons. However,

The use of artificial intelligence (AI) in education in Kazakhstan, particularly in subjects like biology, is continually developing. The country is making notable progress in digital transformation within education, with initiatives such as "Digital Kazakhstan" aimed at improving quality of life through digital technologies, including AI. Moreover, Kazakhstan's Ministry of Education and Science has teamed up with Microsoft to further advance the digital revolution in education. This partnership strives to enhance digital skills and abilities among educators and learners, and to seamlessly integrate digital tools across all levels of the education system, from elementary schools to universities (CEE Multi-Country News Center, 2020). While these are huge efforts by the government, it is still not used and available for the entire Kazakhstan educational community.

Conclusion

The incorporation of AI in biology education has proven to be successful in boosting student involvement and academic achievement. This is accomplished by offering customized learning experiences, adaptable learning settings, and the utilization of AI tools for evaluation and material delivery. The research underscores a number of significant discoveries:

- Improved Academic Results: AI tools have played a significant role in offering tailored and adaptable learning experiences, which meet the unique requirements of students. This individualization has demonstrated potential in enhancing comprehension and recall of biological concepts.
- Enhanced Student Involvement: The implementation of interactive AI technologies, like virtual labs and simulations, has made learning more captivating.
- Improving Teaching Efficiency: AI technology has helped to automate mundane tasks like grading and assessment, giving teachers more time to focus on teaching and engaging with students. This transition has the potential to enhance the overall education experience.
- In addition to the positive results, the study also highlights challenges that must be addressed. These include the necessity for substantial infrastructure improvements, training for educators, and modifying curricula to incorporate AI successfully. Ethical concerns, such as data privacy and potential biases in AI algorithms, also require thorough consideration.

- In the future, integrating AI into education will need strong policy support, ongoing technological advancements, and collaboration among educators, technologists, and policymakers.

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Aknur Zainy¹, Halit Satilmis Yilmaz²

^{1,2}SDU University, Kaskelen, Kazakhstan

e-mail: 231343005@sdu.edu.kz, halit.yilmaz@sdu.edu.kz

INVESTIGATING METHODS FOR DEVELOPMENT OF STEM CHEMISTRY TEACHER CAREERS

Abstract. This literature review investigates methods utilized in enhancing the skills and knowledge of educators in the fields of science, technology, engineering, and mathematics (STEM). Through a systematic analysis of relevant articles, this study aims to identify innovative methods and effective practices implemented in STEM teacher development programs. The review underscores the need for further research to empirically investigate the efficacy of different approaches and inform the development of impactful professional development initiatives for STEM educators. By exploring new avenues and leveraging evidence-based practices, this study aims to contribute to the advancement of STEM education and the cultivation of a skilled workforce for the future.

Keywords: STEM education, STEM Chemistry teacher, Career development.

Introduction

In the ever-evolving field of education Science, Technology, Engineering, and Mathematics (STEM) have emerged as cornerstones of academic and professional development. STEM education is an approach that integrates these disciplines, improves critical thinking, problem-solving skills, and technological literacy. Its significance lies not only in preparing individuals for specialized careers but also in cultivating a broader set of skills essential for navigating the challenges of the modern world. The objective of this study is to identify prevalent methods utilized in the development of STEM teachers.

Literature review

In numerous countries, the inclination towards selecting a STEM career, particularly in fields like chemistry, is diminishing. Certain studies indicate a decline in the choice of chemistry as a major and profession from high school to higher education. Interestingly, women tend to opt for chemistry more frequently than men at both high school and university levels, while minorities exhibit a greater preference for chemistry in high school but a reduced interest in higher education compared to non-minorities (Avargil, S., Kohen, Z., & Dori, Y. J, 2020). High school serves as a critical period for developing or shaping students' interests and career aspirations, particularly in STEM fields. Effective STEM education in high school emphasizes the relevance of STEM concepts to students' lives and future careers. By showcasing how STEM knowledge and skills are applied in various fields, educators can help students understand the practical significance of these subjects, making them more inclined to