Web of Scholars: Multidimensional Research Journal
ISSN: 2751-7543
Volume 04 Number 01 (2025)
https://innosci.org/wos

Article

The Use of Artificial Intelligence Technologies in The Formation of Physical Phenomena in The Minds of Students

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Abstract: Currently, attention to education is a pressing issue worldwide. The article presents a teaching method using artificial intelligence, namely ChatGPT, to form information about physical phenomena in the minds of students in a school physics course, and experimental testing was conducted. The effectiveness of this method among students in school physics lessons was demonstrated on the basis of an experiment.

Keywords: school physics course, artificial intelligence, new pedagogical technologies, ChatGPT, an object thrown obliquely to the horizon

Citation: Rustamovich, M. U. The Use of Artificial Intelligence Technologies in The Formation of Physical Phenomena in The Minds of Students. Pioneer: Journal of Advanced Research and Scientific Progress 2025, 4(1), 17-24.

Received: 10th Feb 2025
Revised: 11th Feb 2025
Accepted: 24th Feb 2025
Published: 28th Feb 2025

1. Introduction

The integration of artificial intelligence (AI) tools into educational processes is becoming increasingly widespread. From the point of view of physics education, AI technologies provide innovative solutions in the learning process, allowing for the implementation of personalised and effective teaching strategies for students [1]. The use of AI in the process of explaining physical phenomena can have a significant impact on the development of students' analytical thinking and problem-solving skills. The development of AI technologies in recent years has paved the way for the creation of educational platforms that are tailored to the individual needs of students [2].

In physics, the integration of SI technologies helps to speed up and simplify the process of solving problems. For example, machine learning algorithms help to draw scientific conclusions by analysing complex data. One of the important aspects of the integration of SI into physics education is the ability to provide real-time feedback and adapt educational materials. At the same time, there are some difficulties in introducing SI technologies into physics education. For example, the level of accuracy of SI tools in explaining some advanced topics may be low. In addition, SI systems may lack useful visual materials or provide incorrect information. To solve these problems, it is important to integrate SI tools into the educational process in a balanced way [2] [3] [4].

In this regard, when using SI technologies, it is necessary for the student or teacher to have basic knowledge. Naturally, the student initially lacks basic information on the subject. Therefore, the role of the teacher is important here. The teacher must be able to form physical phenomena in the minds of students and explain concepts related to the subject.

Literature review

[1] The page offers answers to problems and examples found in the physics textbook for the eighth grade, along with additional issues and theoretical details that are related to them and are enhanced by artificial intelligence.

[2] This article examines the mathematics and real-world applications (in engineering, economics, and education) of solutions to basic linear equations of the type ax + b = 0. The author examines equation-solving algorithms, error-prevention techniques, and simplified approaches to teaching pupils difficult ideas.

[4] [5]The paper examines how artificial intelligence technology might be incorporated into the teaching of physics. The authors examine how artificial intelligence technologies can improve the efficiency of the learning process. They also take into account how these technologies affect instructional strategies and aid in students' physics mastery.

[6] [7] The authors examine the potential for integrating computer models into the teaching process to improve students' physics comprehension. The use of applications like Physikon, Crocodile Physics, Sleeve, Phed, and virtual simulators is covered in the article. It also emphasizes how information technology can be used to run experiments, collect measurement findings, and analyze them.

[8] [9]talks about the function and significance of SI in education and looks at how using it in physics classes might help students learn more. The benefits and possible drawbacks of incorporating SI technologies into the teaching and learning process are also discussed in the essay.

2. Materials and Methods

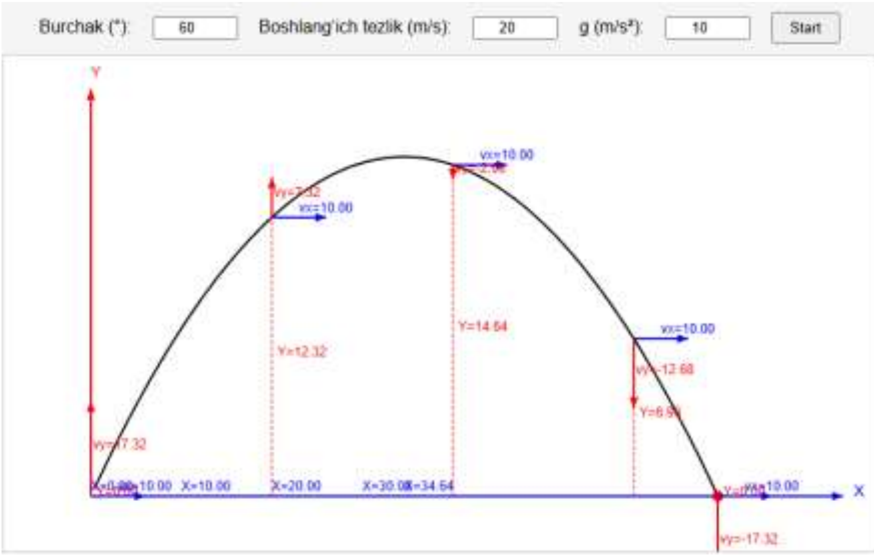
Although the teacher provides all the knowledge on the subject during the lecture and provides complete information about how the phenomenon occurs, the student may not be able to imagine this physical phenomenon. However, when this phenomenon is explained through simulation, complete information about this phenomenon is formed in the student's imagination.

Let's explain this through the topic of "An object thrown diagonally to the horizon", which is difficult for students. In this topic, the object is in a straight line along two axes: the horizontal "x" axis. The object thrown upward along the vertical "y" axis repeats the movement. However, if we pay attention to its movement, the trajectory of the object's movement appears in the form of a parabola with branches pointing downwards. It is difficult for the student to imagine that this parabola is formed as a result of two different movements, so if we show this phenomenon through simulations, it will be much more understandable for the student. For this, the teacher would have to have a deep knowledge of a programming language until now.

Nowadays, this is possible. A teacher can create a simulation of the necessary physical phenomenon without knowing any programming language. For this, it is enough if he has the skills to work with artificial intelligence. We will give this to ChatGPT. For this, we need to give ChatGPT the correct sequence of execution of the necessary phenomenon [8].

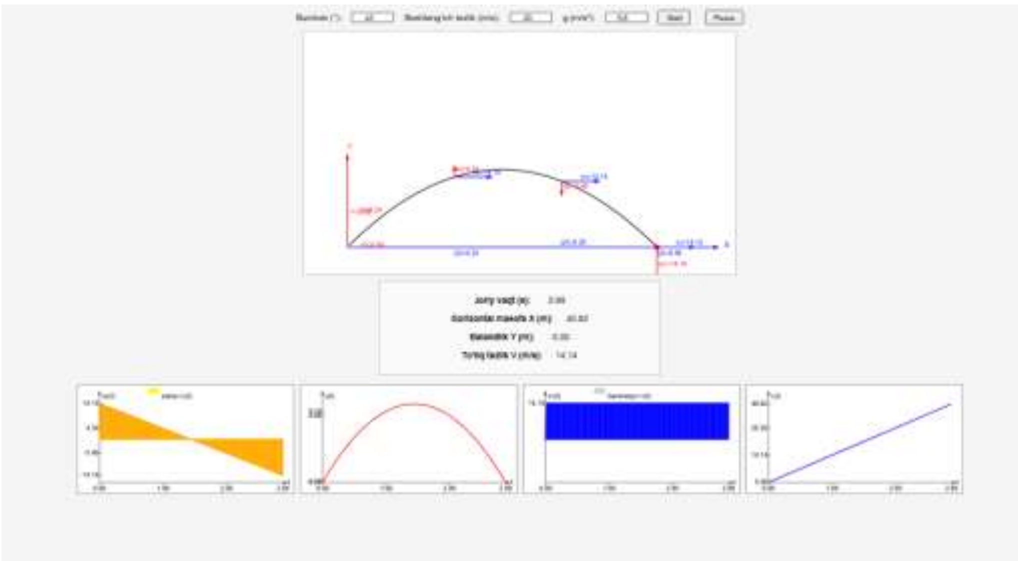
Let's take a closer look. When we asked ChatGPT to "create a simulation of the motion of an object thrown at an angle to the horizon. In this case, the object should give projections of the horizontal and vertical velocities of each second of motion and the velocity in the last second of motion over the trajectory of motion," it created the following simulation for us, you can see it in Figure 1:

Figure 1. An object thrown at an angle to the horizon.



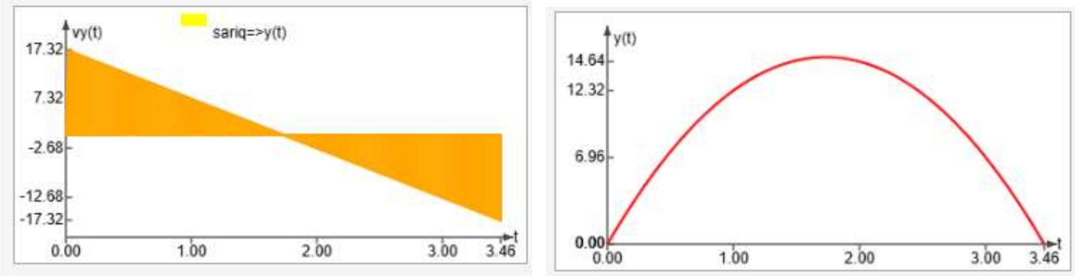
Now we can improve this further. For this, we ask ChatGPT another question. “Great! Create four more windows. In the first of these windows, draw a graph of the vertical motion of an object thrown diagonally to the horizon, the velocity v_y(t). In this case, also give the values of the velocity per second in the graph. In the second window, draw a graph of the vertical motion of the object, the displacement y(t). In the third window, draw a graph of the horizontal motion, the velocity v_x(t). In the fourth window, draw a graph of the horizontal motion, the displacement x(t). In addition, create another button. When you press this button, the motion will stop, and when you press it a second time, the motion will continue from the point it started.” When we gave the command, it created the following simulation. Figure-2 A graphical representation of the motion of an object thrown at an angle to the horizon.

Figure 2. shows the complete simulation. We will show these separately.



The graph on the right in Figure (3) shows the vertical component of the velocity of an object thrown at an angle to the horizon.

Figure 3. Vertical motion graph.

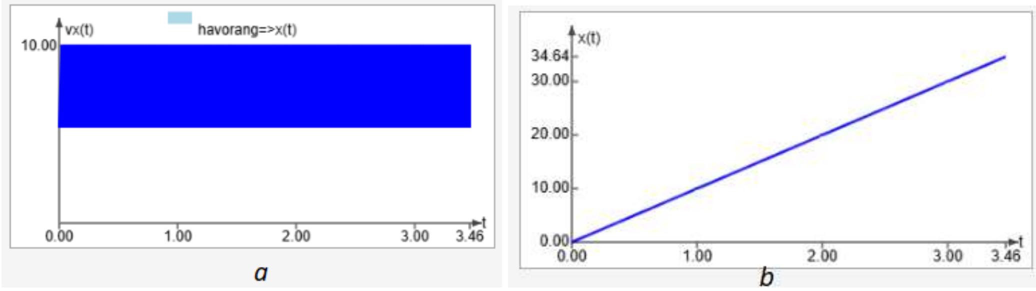


In this simulation, if we set the initial velocity to 20 m/s, the slope angle to 60 degrees, and the acceleration of gravity to 10 $m\backslash s^2$, the value of the velocity at each second is shown on the v_y(t) axis. The shaded area shows the vertical path.

The graph on the left in Figure (3) shows the displacement graph of an object thrown at an angle to the horizon. Here, too, the coordinate of the displacement point at each second is shown on the y(t) axis.

Figure (4) shows the velocity (a) and displacement (b) graphs of the horizontal motion of an object thrown at an angle to the horizon. The numerical values of the velocity and displacement per second are also given.

Figure 4. Horizontal Motion Graph



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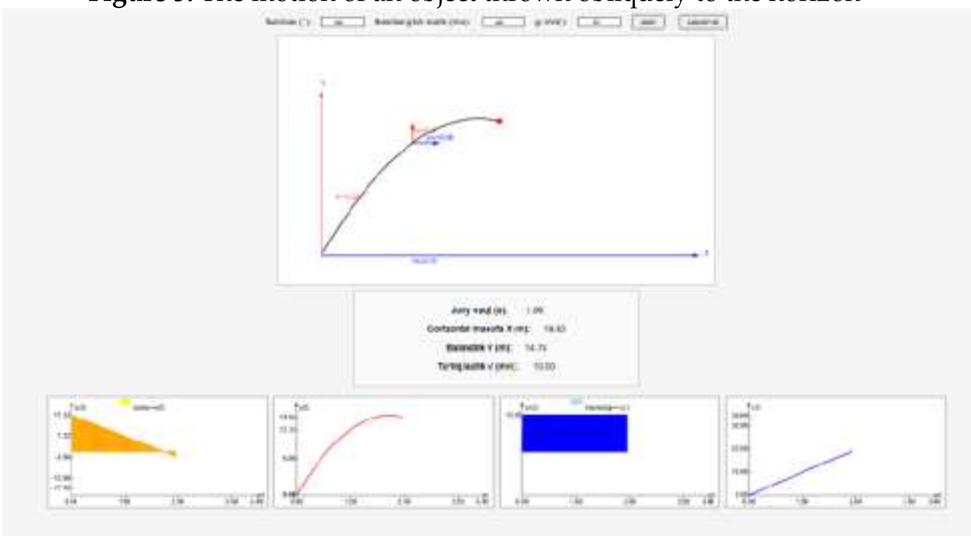
In addition, through this simulation, it is possible to understand how the object stops and continues its motion at any time (as in Figure 5)), its vertical displacement and speed at this point, and its straight motion in the horizontal direction.

Figure 5. The motion of an object thrown obliquely to the horizon



Through the above, it is possible to create an image in the minds of students about an object thrown at an angle to the horizon. This will help students to perfectly master the knowledge about an object thrown obliquely to the horizon and imagine it.

3. Results

We tried this on the example of this topic in schools. For this, we conducted experimental and test work among students of grades 7 "A" and 7 "B" of Bukhara city school 26. Class 7 "A" was selected as the control group, and class 7 "B" was selected as the experimental group and the topics were conducted in the control group traditionally. In the experimental group, the topics were taught using new pedagogical technologies, that is, each physical phenomenon and process was taught using simulations and animated demonstrations by table 1.

Table 1. Indicator of the formation of students' knowledge, skills and competencies in physics.

Academic year in which the experiment was conducted	Educational institutions	Mastery level	At the beginning of the experiment		At the end of the experiment	
			In the experimental group	In the control group	In the experimental group	In the control group
2024 Academic year	Bukhara city school number 26	The highest (excellent))	9 (29%)	7 (23%)	13 (45%)	9 (30%)
		High (good)	12 (39%)	13(43%)	15 (48%)	14 (47%)
		Medium (satisfactory)	10 (32%)	10(34%)	3 (7%)	7 (23%)

The knowledge acquired by students in the groups according to state educational standards was analyzed to determine whether it meets the requirements. In order to determine the effectiveness of teaching based on new pedagogical technologies in teaching physics, students were asked questions, tests and problems on the topics on which the experiment was conducted.

The analysis of the experimental work was carried out using mathematical and statistical methods from the scientific research methods of pedagogy.

Table 2 below shows the dynamics of changes in the level of knowledge of students during the process of teaching based on new pedagogical technologies (in numbers and %).

At the beginning of the experiment: Experimental group $T_{quality} = \frac{9+12}{31} = 68\%$

Control group $T_{quality} = \frac{7+13}{30} = 67\%$

At the end of the experiment: Experimental group $T_{quality} = \frac{13+15}{31} = 90\%$

Control group $T_{quality} = \frac{9+14}{30} = 71\%$

Table 2. Analysis of students' knowledge of physics

Experience level and academic year	Educational institutions	Mastery level	At the beginning of the experiment		At the end of the experiment	
			In the experimental group	In the control group	In the experimental group	In the control group
2024		Acquisition rate	100%	100%	100%	100%
		Quality indicator	68%	67%	90%	71%

Academic year	Bukhara city school number 26	Difference in quality index			+22%	+4%

Figure 6 presents a histogram illustrating the results obtained from the control group, which was taught using traditional teaching methods. As can be seen from the figure, although there is a slight improvement in students' performance at the end of the experiment, the overall mastery level remains relatively moderate.

Figure 6. Histogram of control group results

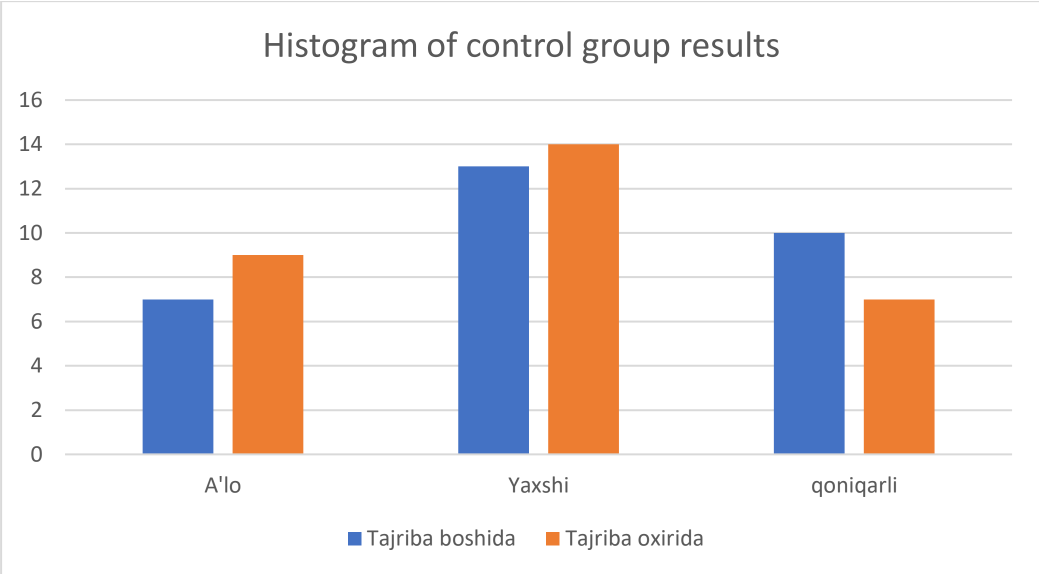
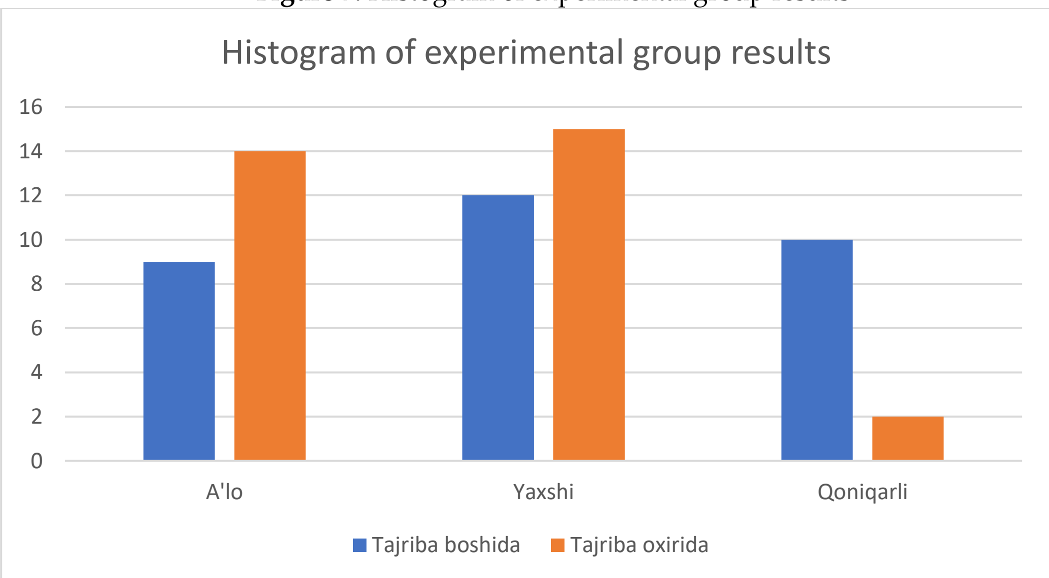


Figure 7 shows a histogram depicting the results from the experimental group, which was taught using artificial intelligence-supported simulations and new pedagogical technologies. Compared to the control group, the experimental group shows a notable improvement in students' performance. A higher proportion of students achieved "excellent" and "good" mastery levels, while the number of students with only a "satisfactory" level of understanding significantly decreased. This indicates that the integration of AI-based simulations positively impacted students' ability to comprehend and internalize complex physical concepts, leading to higher learning outcomes.

Figure 7. Histogram of experimental group results



4. Discussion

The findings of this study underscore the transformative potential of artificial intelligence (AI), specifically ChatGPT, in enhancing students' conceptual understanding of complex physical phenomena. By utilizing AI-generated simulations, students were better able to visualize abstract concepts such as projectile motion, which is typically challenging to grasp through traditional methods alone. The comparative results between the control and experimental groups highlight a significant improvement in the experimental group's learning outcomes, confirming that interactive simulations and real-time visualizations foster deeper engagement and cognitive retention. These results align with current pedagogical trends emphasizing personalized, technology-enhanced learning, suggesting that AI tools, when appropriately integrated, can serve not only as a complement to the teacher's instruction but also as a catalyst for active, student-centered learning environments.

5. Conclusion

As can be seen from the above experimental work, the experimental group had a higher growth rate than the control group. It can be concluded that conducting lessons using new pedagogical methods compared to traditional lessons not only leads to an increase in students' knowledge, skills and abilities, but also serves to expand their imagination. As can be seen from the experimental work, explaining physical phenomena through various simulations helps students better understand the essence of this topic.

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