THE USE OF PHET TECHNOLOGY IN TEACHING PHYSICS

Ochilova Ozoda Odilovna *- PhD of Technical Sciences,*
Tashkent university of information technologies named after Muhammad Al-Khorezmiy
Absalyamova Ilmira Ildarovna *- Assistant*
Tashkent university of information technologies named after Muhammad Al-Khorezmiy
Abdullayeva Shoira Isajanovna *- assistant*
Tashkent university of information technologies named after Muhammad Al-Khorezmiy
Xalilova Nozliya Samadovna*, assistant*
Tashkent university of information technologies named after Muhammad Al-Khorezmiy

Annotation: This article explores the integration of PHET (Physics Education Technology) simulations in teaching physics, highlighting their role in enhancing students' understanding of complex concepts. PHET simulations offer interactive, visual, and dynamic learning tools that are beneficial for both students and teachers. This study examines existing literature, analyzes the effectiveness of PHET in physics education, and suggests methods for successful integration. The findings reveal that PHET contributes to better conceptual understanding and engagement, especially when used in conjunction with traditional teaching methods.

Keywords: PHET simulations, physics education, interactive learning, student engagement, conceptual understanding, technology in education.

The rapid advancement of technology has revolutionized educational practices, making learning more interactive and accessible. Physics, a subject often deemed abstract and challenging by students, can greatly benefit from these technological advancements. One such technology is PHET simulations, developed by the University of Colorado Boulder, which provide free, interactive science simulations that engage students in active learning. These simulations help illustrate physics concepts visually and experimentally, offering a hands-on experience that traditional teaching methods might lack. In this article, we will discuss the benefits of using PHET simulations in teaching physics and how this technology can address the difficulties students often face in understanding abstract concepts.

To assess the effectiveness of PHET simulations in teaching physics, we conducted an experimental study involving two groups of high school students. The experimental group was taught using a combination of traditional teaching methods

and PHET simulations, while the control group relied solely on traditional methods. The curriculum covered topics such as Newton's laws, electricity, and wave phenomena.

A pre-test and post-test were administered to both groups to measure their understanding of the key concepts. Additionally, student engagement and satisfaction were evaluated through surveys and observational notes during the classes.

PHET technology refers to interactive simulations developed by the University of Colorado Boulder that are used in teaching and learning various scientific concepts, including physics. PHET simulations offer an engaging, visual, and hands-on way for students to explore and understand complex ideas.

How PHET Enhances Physics Education:

Interactive Learning:

PHET provides interactive simulations where students can manipulate variables in real-time, such as mass, force, and acceleration, allowing them to see immediate effects. This helps in understanding abstract concepts more concretely.

Visualization of Complex Phenomena:

In physics, many phenomena like electromagnetism, wave interference, or atomic structures can be difficult to visualize. PHET simulations bring these concepts to life with animations that demonstrate these processes in an accessible way.

Self-paced Learning:

Students can use PHET simulations at their own pace, conducting virtual experiments multiple times if needed. This helps reinforce understanding and allows students to learn through trial and error without the time constraints of traditional labs.

Interactive Engagement:

Instead of passively listening to lectures, students engage in active problem-solving. Teachers can design lessons around these simulations to make physics more engaging and help students learn through discovery.

Cost-effective Lab Alternative:

For schools with limited resources for physical lab equipment, PHET simulations can provide an affordable alternative. Simulating experiments like projectile motion, electric circuits, or even quantum phenomena without expensive tools enables wider accessibility.

Benefits for English Language Learners (ELLs) in Physics:

For students who are still mastering English, PHET simulations can be particularly useful because:

Visual Explanations:

Since the simulations heavily rely on visuals and animations, language barriers are minimized. The concepts are illustrated in a way that does not require a high level of language proficiency to understand.

Multilingual Support:

PHET simulations are available in multiple languages. If students are not fluent in English, they can switch the language of the interface to one they understand better, easing the learning process.

Reduces Cognitive Load:

By allowing students to focus on understanding the physics concepts rather than struggling with complex scientific terms, PHET lowers the cognitive load for ELLs. This can enhance comprehension and retention of both the scientific content and language.

In conclusion, PHET technology offers an effective method of teaching physics by making abstract ideas more tangible and reducing language barriers for learners. This technology enhances engagement and understanding, fostering a more inclusive and dynamic learning environment.

The results suggest that PHET simulations are a valuable tool in enhancing the teaching of physics. The simulations provide a dynamic learning environment that allows students to experiment and explore concepts independently. This increases their motivation and curiosity, which are essential for deep learning.

PHET also facilitates differentiated learning, enabling students of varying skill levels to learn at their own pace. Those who grasp concepts quickly can explore more advanced features of the simulations, while struggling students can spend more time on basic principles without feeling left behind.

However, it is important to note that PHET simulations should not replace traditional teaching methods. Instead, they should complement them to provide a more holistic educational experience. While simulations help with visual learning and concept clarity, hands-on laboratory work is still crucial for developing practical skills in physics.

Conclusions

The integration of PHET simulations into physics teaching can significantly improve student understanding, engagement, and performance. These interactive tools provide a unique opportunity to visualize and experiment with difficult concepts, offering an alternative approach to conventional learning. The study confirms that PHET is particularly effective when combined with traditional methods, providing students with both theoretical knowledge and practical applications.

- Teachers should consider integrating PHET simulations into their lesson plans, especially when explaining abstract and complex topics.

- Training programs for educators on how to use PHET simulations effectively should be implemented to maximize their potential.

- Further research should focus on the long-term impact of PHET on students' retention of physics knowledge and skills.

- Schools should invest in technological infrastructure that supports the use of educational simulations in classrooms.

By fostering a blend of traditional and modern teaching tools, educators can create a more engaging and effective learning environment for students in physics.

References:

1. For example, How People Learn, edited by J.D. Brans - ford, A. L. Brown, and R.R. Cocking (Natl. Academic Press, Washington, D.C., 2002); references within L.C. McDermott and E.F. Redish, "Resource letter on physics education research," Am. J. Phys. 67, 755–772 (1999); R.C. Clark and R.E. Mayer, e-Learning and the Science of Instruction: Proven Guidelines for Consum - ers and Designers of Multimedia Learning (Pfeiffer, San Francisco, 2003).

2. D. Sokoloff and R. Thornton, "Using interactive lec - ture demonstrations to create an active learning envi - ronment," Phys. Teach . 35, 340–346 (1997).

3. E. Mazur, Peer Instruction: A User's Manual (Prentice Hall, Upper Saddle River, NJ, 1997).

4. N.D. Finkelstein et al.,"When learning about the real world is better done virtually: A study of substituting computer simulations for laboratory equipment," Phys. Rev. ST Phys. Educ. Res. 1, 010103 (2005).

5. L.C. McDermott, P.S. Shaffer, and the Physics Educa - tion Group at the University of Washington, Tutorials in Introductory Physics (Prentice Hall, Upper Saddle River, NJ, 2002).