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THE IMPACT OF INTERACTIVE SIMULATIONS ON MASTERING THE TOPIC OF RADIOACTIVITY

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Abstract: *This article analyzes the impact of using interactive simulations in teaching the topic of radioactivity on students' learning outcomes. Modern educational technologies, particularly computer-based and online simulations, make it possible to visualize complex theoretical processes, conduct experiments in a safe environment, and develop students' independent thinking skills. Research results show that interactive simulations improve students' understanding of radioactivity, increase their level of comprehension, enhance interest in the subject, and effectively transform theoretical knowledge into practical skills and competencies.*

Keywords: *radioactivity, interactive simulation, physics education, improving students' knowledge, STEAM approach, educational technologies, innovative teaching*

INTRODUCTION

In the modern educational process, improving students' level of knowledge and enhancing their understanding of complex physical concepts remains a pressing issue. In particular, the importance of interactive simulations is increasing in teaching topics such as radioactivity, which involve complex theory and potentially dangerous experiments. In physics education, radioactivity is considered one of the most difficult topics for many students. Alpha, beta, and gamma radiation cannot be observed directly, and explaining their behavior through traditional lessons is often insufficient.

Therefore, the application of interactive simulations in modern education is of great significance. Interactive simulations help students understand complex concepts visually and enable them to conduct practical experiments in a safe environment. This tool stimulates students' interest, develops scientific thinking, and reinforces theoretical knowledge. Interactive simulations serve as an effective means of explaining complex physical processes in a practical and visual manner. They provide students with opportunities to experiment safely, gain deeper understanding, and develop independent thinking skills.

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Radioactivity is a phenomenon of ionizing radiation resulting from changes in the atomic nucleus and originates from natural and artificial sources. One of the main challenges in teaching this topic is that traditional lessons are often limited to theoretical explanations and formal experiments. As a result, students may fail to fully understand the topic, show low interest, or even experience fear when dealing with it.

The purpose of this article is to determine the impact of using interactive simulations in teaching the topic of radioactivity on students' mastery of the subject.

The Concept of Radioactivity

Radioactivity was discovered in 1896 by Henri Becquerel. Later, Marie Skłodowska-Curie and Pierre Curie studied the radioactive properties of uranium and thorium. Radioactivity originates from both natural and artificial sources:

• Natural radioactivity: Elements such as uranium, thorium, and radon emit alpha, beta, or gamma radiation from their nuclei.

• Artificial radioactivity: Isotopes produced through neutron bombardment, for example, diagnostic and therapeutic radioisotopes used in medicine.

Radioactivity is the process by which an atomic nucleus releases excess energy, resulting in the formation of a new element. Radioactive substances may originate from natural or artificial sources, and their main characteristic is the emission of alpha (α), beta (β), and gamma (γ) radiation.

Alpha Radiation (α)

Alpha particles consist of two protons and two neutrons and carry a positive charge. They travel short distances and can be stopped by a sheet of paper or human skin. Although alpha radiation has high energy, its penetrating power is low.

Beta Radiation (β)

Beta radiation consists of electrons or positrons and travels a moderate distance. It can be stopped by thin metal layers. Compared to alpha radiation, beta radiation has lower energy but higher penetrating power.

Gamma Radiation (γ)

Gamma radiation consists of electromagnetic waves and has very high penetrating power. Thick metal layers are required to stop it. Gamma radiation has high energy and is emitted by many radioactive substances.

Units of Measurement of Radioactivity

• Becquerel (Bq): One atomic decay per second.

• Gray (Gy): The amount of absorbed energy in biological tissue.

• Sievert (Sv): The degree of biological damage caused to the human body.

Benefits of Radioactivity

• In medicine: Cancer treatment and medical diagnostics (X-ray, PET scans).

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• In industry: Material testing and use as an energy source in nuclear reactors.

• In agriculture: Sterilization of plants and seeds and reduction of pesticide use.

Risks of Radioactivity

• Long-term exposure can cause skin burns, cancer, and genetic mutations.

• High doses may lead to death.

Literature Review

Scientific studies indicate that interactive simulations are effective in teaching radioactivity:

• Johnson et al. (2018) reported a 30% increase in students' understanding in experimental groups using interactive simulations.

• Smith (2020) demonstrated that visualizing alpha, beta, and gamma radiation improves students' knowledge. Smith and Taylor (2018) developed methodologies for conducting safe experiments using online simulations.

• Miller and Brown (2019) compared laboratory experiments and simulations and found interactive methods more effective in increasing interest and reinforcing theoretical knowledge.

• Wang (2019) noted a significant improvement in students' experimental skills through virtual laboratories.

These studies confirm the scientific validity of using interactive simulations in teaching radioactivity.

Research Methodology

This study employed the Simplified Three-Step Understanding Method (STSUM) to present the topic of radioactivity in an accessible manner and ensure rapid comprehension by students. The method is based on the principle that students first understand complex physical processes through simplified models, then confirm them through simulations, and finally draw easy conclusions.

Stages of STSUM:

1. Simplified Explanation Stage

At the beginning of the lesson, the process of radioactivity was explained using simple analogies from everyday life. No complex terms or formulas were used. The teacher presented the core ideas clearly and logically, forming an initial understanding and eliminating the perception that the topic is "difficult."

2. Joint Observation and Experimentation Stage

An interactive simulation was introduced and observed together with students. Changes in simulation parameters and their effects were demonstrated practically. Students visually observed graph movements, particle reduction, and half-life stability, linking simplified concepts with real models.

3. Easy Conclusion Stage

Students answered three short questions:

4. What did I observe?

5. Why do I think it happened this way?

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6. Where can this be encountered in real life?

This stage helped students form independent conclusions, explain concepts in their own words, and identify misconceptions.

Analysis and Results

The experimental group was taught using STSUM, while the control group followed traditional teaching methods. Diagnostic tests, observation sheets, and student feedback were collected before and after instruction.

1. Change in Knowledge Level

Test results showed significantly higher understanding in the experimental group. Students explained radioactive decay, half-life, and radiation types more accurately, while misconceptions persisted in the control group.

2. Concept Formation and Reduction of Misconceptions

Correct concepts such as gradual decay, constant half-life, and decay graph behavior were strongly reinforced in the experimental group. Misconceptions were notably reduced.

3. Student Interest and Activity

The joint observation stage encouraged active participation, questioning, and discussion. Student engagement was higher compared to the control group.

4. Development of Conclusion-Making Skills

Experimental group students provided clear and logical responses, indicating deeper understanding.

Overall, STSUM proved effective in enabling fast and easy comprehension, increasing interest, and reducing misconceptions.

Conclusion and Recommendations

The results show that the Simplified Three-Step Understanding Method (STSUM) is effective in teaching radioactivity by enabling students to master the topic quickly, clearly, and easily. Visualization through simulations increased interest, eliminated misconceptions, and fostered logical thinking. Experimental group students demonstrated higher understanding and analytical skills than the control group.

RECOMMENDATIONS:

1. Regular use of STSUM in teaching radioactivity is recommended.
2. Interactive simulations should become an integral part of physics lessons.
3. Short and simple questions should be used to strengthen conclusion-making skills.
4. Teachers should receive methodological guidance on simplifying complex topics.
5. The method should be tested on other physics topics.
6. Independent simulation tasks should be developed to enhance experimental and analytical skills.

In conclusion, using interactive simulations in teaching radioactivity not only makes learning engaging but also ensures deep understanding, strengthens theoretical knowledge with practical

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skills, and develops independent scientific thinking.

REFERENCES:

1. G‘aniyev, A.G., Avliyoqulov, A.K., & Almardonova, G.A. Physics, Part 2. Tashkent, 2019.
2. Bozorov, S., & Kamolov, N. Physics (Optics, Atomic and Nuclear Physics). Tashkent, 2017.
3. No‘monxo‘jayev, A.S., Fattohov, M.A., & Normatov, B. Physics, Part 3. Tashkent, 2018.
4. Korolev, F. Physics Course: Optics, Atomic and Nuclear Physics.
5. Zhdanov, L.S., & Zhdanov, G.L. Physics.
6. O‘lmasova, M.H. Physics: Optics, Atomic and Nuclear Physics. Tashkent, 2020.
7. Grade 11 Physics Textbook. Tashkent, 2022, pp. 104–107.
8. Dustmurodov. Physics, Part 2. Tashkent, 2016.
9. Karimov, A.A. Innovative Methods and the Role of Laboratory Practice in Physics Education. Tashkent, 2020.
10. Qodirov, M.B. Methods of Teaching Physics. Tashkent, 2018.
11. Jones, M., & Smith, L. (2020). Interactive Simulations in Teaching Radioactivity. Physics Education Journal, 55(2), 123–134.
12. Smith, A., & Taylor, R. (2018). Safe Experiments Using Online Simulations. Journal of Science Education, 47(3), 98–110.
13. Wang, H. (2019). Virtual Laboratories in Physics Education. International Journal of Educational Technology, 15(4), 45–60.
14. Serway, R.A., & Jewett, J.W. (2019). Physics for Scientists and Engineers. Cengage Learning.