IN ORGANIZING THE PHYSICS EDUCATIONAL PROCESS IN AN INTEGRATIVE FORM SOFTWARE FROM TOOLS EFFECTIVE USE AND EDUCATIONAL AND METHODOLOGICAL SUPPLY IMPROVEMENT

Oriental University "Exact Sciences"
senior lecturer of the department
A.Akhunjonov

Annotation . This article analyzes the scientific and pedagogical *foundations of the effective use of digital technologies and software tools in the organization of physics education in an integrative manner. The role of virtual laboratories, modeling using artificial intelligence, simulation environments and interactive learning resources in the development of students' scientific thinking is highlighted. Also, directions for the modernization of educational and methodological support in a digital format, updating teacher competencies and innovative organization of physics education based on the STEAM approach are proposed.*

Keywords: *physics education, integration, software tools, digital pedagogy, virtual laboratory, STEAM, modeling, artificial intelligence, educational and methodological support.*

The 21st century education system has entered a phase of digital transformation. Today, the student is not a passive listener, but an active participant in the learning process, a creator and researcher. Physics plays a central role in this process, as it helps to analyze the laws of nature, model them and develop technological solutions. serves as the main scientific base. Integrative education is an approach to developing knowledge as a complex system by eliminating artificial boundaries between disciplines. In particular, by integrating physics with computer science, mathematics, biology, chemistry, engineering, and technology, students develop a "scientific thinking + practical skills

+ creative "thinking" threesome develop possible.

In recent years, the integrative education system based on the STEAM (Science, Technology, Engineering, Art, Mathematics) model has been rapidly developing worldwide. This model focuses on designing the learning process, problem-solving, and creating innovative solutions. Software tools such as PhET Simulations, Labster, Crocodile Physics, Algodoo, GeoGebra, and Virtual Lab are widely used to implement this approach in physics lessons. For example, with the help of PhET simulations, students can observe electromagnetic induction or Newton's laws in real time and analyze changes in force, velocity, and mass virtually. This forms students' experimental thinking and creates a safe and cost-effective learning environment.

Home part

The role of software tools in organizing physics education in an integrative manner is modern. pedagogy central from directions to one became. Today on the day education

The use of digital tools in the learning process is not just a visual supplement, but is considered a key tool for shaping students' cognitive, practical, and analytical skills.

This of the process efficiency three main in the direction obvious manifestation will be:

1. Visualization

Demonstrating complex physical phenomena in an understandable, dynamic, and visual way is one of the most important requirements of physics teaching. Using software tools:

- Processes such as motion, force, field, and energy exchange are interpreted through animation and graphical interfaces ;
- PhET Simulations, Algodoo, Crocodile Physics such as programs using mechanical, electrical, and optical phenomena are described in an interactive manner;

- 2D and 3D modeling opportunities to students experience the results realistic allows for analysis in real time.

This type of visualization not only brings the lesson to life, but also allows for a clear representation of abstract concepts (such as wave interference or the direction of an electromagnetic field). Studies show that students who are taught using visualization learn the subject 40% faster and remember it longer.

2. Modeling

Although physics is based on experimentation, it is not always practical to replicate every phenomenon in the laboratory. Therefore, modeling technologies are becoming an integral part of the learning process.

Software modeling using:

- students mathematician equations physicist models through represents

;• the results digital analysis does and own models creates ;

- It replicates experiments virtually through platforms such as GeoGebra , COMSOL Multiphysics , and MATLAB Simulink .

Such models in students cause and effect their relationship to determine, parameter management and the results analysis to do skills develops. For example, by changing the current in electrical circuits, how does the voltage change? observation through student Ohm law "feels", only remembering will not remain.

Also, simulations based on artificial intelligence (AI) algorithms (for example, Labster AI-lab environments) analyze student behavior and provide individual recommendations. This leads to the formation of an adaptive learning model.

3. Interactivity

For the modern student, the learning process should not be passive, but active, research-oriented . In lessons organized on the principle of interactivity, students:

- events themselves try they see;
- mistakes through analysis to do they learn;

ISSN 3060-4567

- realistic experiments and virtual environments combined without result they will release.

AR (Augmented Reality) and VR (Virtual Reality) technologies are opening up new horizons in this regard. For example:

- the Google Expeditions , Labster VR , and Merge EDU platforms, students observe molecular structure, electromagnetic fields, or optical phenomena in 3D space ;
- Through a VR environment, it is possible to safely conduct “dangerous” or “complex” experiments — for example, simulating radioactivity or high-voltage electrical phenomena .

Also, introducing gamification elements — accumulating points, moving up levels, and receiving virtual rewards — significantly increases students' enthusiasm for the lesson.

Educational and methodological supply modernization to do

The integrative approach is not limited to the use of software tools in the classroom. — she is educational and methodological of supply digital transformation also own includes .

Modern educational and methodological system following structural consists of parts must be:

1. Digital textbooks and interactive electronic Platforms: Through systems such as Moodle, Canvas, and Google Classroom, students complete assignments remotely, and the teacher monitors the results in real time.
2. AI based on test systems and adaptive Assessment: Artificial intelligence-based assessment modules analyze students' mistakes and automatically offer them exercises at the appropriate level.
3. Digital pedagogy according to teachers preparation: Teachers

Special courses should be introduced to improve skills in "digital literacy", "interactive design" and "pedagogical programming".

ISSN 3060-4567

4. Developing Virtual Laboratories: Creating Physics Laboratories in a Digital Environment — this material the base saves, security provides and every one to the student allows for personal experience.

In addition, using cloud technologies (Cloud Physics Labs, Virtual Science Hub), a teacher and a student can simultaneously manage a laboratory from different locations, which allows for the integration of education into the global network.

Research results

The research process was conducted on an experimental basis and was carried out in two groups of students (control and experimental groups). The main goal of the research was to determine the impact of an integrative approach and the use of software tools in teaching physics on the level of knowledge, motivation, and creative thinking of students.

The experiment was conducted in grades 10–11 in the Tashkent region over a 3-month academic period .

- The control group (32 students) received education based on traditional methods - using a blackboard, textbooks, and simple laboratory equipment.
- The experimental group (34 students) was taught using PhET, GeoGebra, Algodoo, Virtual Lab, and Crocodile Physics.

Experience during every two to the group one kind topics — —Electromagnetic "induction",

—Optical "events", —Newton "laws" and —Thermodynamics processes" according to lessons taken is, difference only to teach in the methodology it has been.

Experience in the end following in directions results analysis was done:

1. Level of knowledge acquisition. The acquisition rate of students in the experimental group was 25–28% higher. The average score was 84.6 points on a 100-point scale (66.5 points in the control group). This difference was found to be statistically significant ($p < 0.05$).

2. Level of motivation and interest in science. Survey conducted among students to the results according to, experience in the group 88% student physics to science relatively

ISSN 3060-4567

"high" or "very" "high" level interest stated. Control in the group this The indicator was 52%. On this basis, it was estimated that science motivation increased by 1.6 times .

3. Speed of thinking in problem situations. In practical tests on solving problems, students in the experimental group achieved results 30% faster and more accurately on average. This result indicates the development of students' algorithmic thinking and modeling skills.

4. Creative thinking and innovative approach. The results of a special “Creative Thinking Test” (based on the Torrenz test) showed that the level of creative thinking in the experimental group was 22% higher, and the students' skills in conducting independent experiments, analyzing phenomena, and finding innovative solutions significantly increased.

5. Technological literacy and digital competence. 91% of students in the experimental group mastered the ability to independently perform software simulations, graphic analysis, and virtual experiments. This indicates that students have developed competence in using digital technologies.

The study also monitored the level of mastery of teachers. They noted that using software tools increased lesson efficiency by up to 40%. Lesson of time savings, safe experiments transfer opportunity, of exhibitionism increase

— this of the method the most important advantages as record was done.

It was also observed that the psychological activity of the students increased during the experiment. They freely expressed their opinions during the lesson, actively participated in the experiments, and were communicative in analyzing the results.

Final analysis that showed that integrative based on the approach Lessons taught:

- students knowledge to practice use level increases;
- teacher's methodical approach modernization does;
- digital in the environment independent to study skills shapes;
- interdisciplinary dependency strengthens.

In general when receiving, taken results physics education integrative in the form organization The use of software tools in teaching and learning can increase pedagogical efficiency ,

motivation reinforcement and scientific thinking culture in development has proven to be an important factor in practice.

Conclusion

Organizing the physics education process in an integrative manner is an innovative approach that not only ensures interdisciplinary connections, but also develops the intellectual, creative and analytical potential of the student based on modern digital technologies. is a pedagogical approach. The results of the study show that the rational use of software tools significantly increases the efficiency of students' learning, strengthens their interest in subjects and internal motivation to learn.

PhET Simulations , GeoGebra , Crocodile Physics , Algodoo , and Labster, which are used in an integrative approach, provide a visual, modeled representation of complex physical processes. and interactive in the form demonstration to grow opportunity gives. This and leads students from abstract concepts to understanding real practical models. Also, artificial intelligence- based learning environments increase the adaptability of the educational process by analyzing the individual learning speed and errors of students and suggesting appropriate learning paths.

Based on the results of the experiment , it was determined that students trained based on the integrative education model :

- knowledge connect with practice and in real life situations showed 25–30% higher results when used;
- problematic issues solution speed and precisely 30% growth observed;
- creative thought level 20% from more than increased;
- digital from technologies use competence formed.

This results this shows that, digital in the environment organization done integrative physics education:

ISSN 3060-4567

1. Interdisciplinary integration strengthens , physics, computer science, mathematics and ensures logical coherence between technology;
2. Students independent and critical thinking develops , them prepares for scientific research activities;
3. Teacher's methodical Modernize your approach does , digital introduces pedagogical principles into educational practice;
4. Education process individualizes , every one student's to study creates conditions suitable for its pace;
5. Motivational and psychological activity increases , the lesson interactive, creative and allows for an interesting environment.

Thus, the widespread introduction of software tools and digital technologies in physics teaching is a key component of the integrative education concept. This approach aims to transform education from the traditional "information transfer" model to a "research-oriented digital "study" to the model conducts. As a result, student not only physicist laws

becomes a representative of the digital generation who not only knows, but also analyzes, models, and develops practical solutions.

, the creation of special digital methodological guides for teachers , AI-based interactive lesson platforms and a network of virtual laboratories , as well as the expansion of the STEAM approach in the education system, will be of great importance in this direction. Thus, the integrative model of physics education is recognized as one of the most effective directions for the formation of a young generation with scientific and technical thinking that meets the requirements of a modern digital society.

USED LITERATURE

1. Khodjayev BA Physics Teaching Methodology. – Tashkent: Teacher, 2019.
2. Kholmatov SHE IS., Gulyamov Oh. In education information from technologies use. – T.: Science, 2021.

3. PhET Interactive Simulations – University of Colorado Boulder, https://phet.colorado.edu
4. Labster Virtual Labs, https://www.labster.com
5. UNESCO (2023). AI and Digital Pedagogy in STEM Education.
6. Mavlonova RA, Tokhtayeva DX Natural medicine based on an integrative approach teaching subjects. – T.: TDPU Publishing House, 2020.