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**Daniel James**

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# Technology and Innovation in Management Practices 2025

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# INNOVATIVE TECHNOLOGIES FOR TEACHING PHYSICS


## S S JAYABALAKRISHNAN

*Assistant Professor of Physics & Head, Mannar Thirumalai Naicker College, Madurai, Tamil Nadu*



## ABSTRACT

This paper investigates how digital learning tools can improve physics teaching. According to the authors, these technologies can offer chances for individualized and flexible instruction as well as include students in active and collaborative learning experiences. The article examines the possible effects of a number of digital technologies on student learning outcomes, including mobile applications, virtual reality, and simulations. The authors also point out the advantages of using digital tools in physics education, including higher levels of student engagement and motivation, better conceptual comprehension, and greater problem-solving abilities. The constraints and difficulties of integrating digital technologies are also covered in the piece, including concerns about fairness, accessibility, and teacher preparation. The authors stress in their conclusion the need of using digital tools in physics education with consideration for both student requirements and educational objectives. This paper highlights the need for more research and development of these tools while offering a useful summary of the possible advantages and difficulties of using digital educational technologies in physics instruction.


**Keywords:** Mobile applications, Virtual reality, Simulations, Physics training, Digital educational technologies, ICT, Individualized instruction, Adaptive instruction, Student learning outcomes

## INTRODUCTION

These days, a teacher's work should focus on the on-going pursuit of new ideas, introspection, understanding the psychological underpinnings of the learning process, and refining knowledge presented in contemporary culture. This will therefore broaden the teacher's professional interests, encourage the need to read methodological literature, and establish the necessary conditions for carrying out basic, pedagogical, and psychological research. The quality of innovation will be guaranteed by efficient scientific and pedagogical training. The teacher is properly prepared for the on going enhancement of the educational process and has a thorough understanding of cutting-edge technologies. In order to introduce new approaches in education, it is mainly necessary to update the curriculum, use cutting-edge technologies and contemporary teaching techniques, organize the management of the educational process on a scientific basis in accordance with contemporary socioeconomic conditions, and develop pedagogical and scientific foundations for teacher retraining and advanced training. The primary goal of cutting-edge educational technologies is to raise the standard of instruction inside the continuous education system. Students' personal traits are developed and enhanced by innovative technologies, which are the future means of knowledge transfer and application of contemporary information technology.

Any technology intended to improve the teaching and learning process is referred to as a digital educational technology. Mobile apps, virtual reality, and simulations are a few examples of digital technologies that can be used in physics education. Simulations are among the most popular forms of digital technology used in physics education. Through the use of computer programs that mimic real-world events, simulations enable students to change factors and see the results. Simulations can be used to give students the chance to participate in inquiry-based learning or to demonstrate difficult ideas, like how electrons behave in a magnetic field. Because they may provide students a hands-on experience with ideas that are challenging to visualize or manipulate in real life, simulations are especially helpful for teaching physics.

Additionally, the usage of mobile applications in physics education is growing. Students can access interactive lessons, physics simulations, and other learning materials at any time and from any location with the help of mobile applications. Students who want to learn at their own pace or who have limited access to typical classroom tools may find this especially helpful.

Physics courses and subjects saw low student performance (Agbele, Oyelade, & Oluwatuyi, 2020; Stephen, 2016). Students' performance in science classes, especially physics, has been hampered by a lack of resources, a bad teaching and learning environment, and a poor teaching methodology (Ugwuanyi & Okeke 2020). Furthermore, despite their advantages, traditional teaching methods including project-based learning, problem-based learning, student-centered learning, and demonstration have not been proven to be successful in fostering interest or enhancing knowledge acquisition. Simultaneously, studies have shown that incorporating information and communication technology (ICT) into physics curricula can simplify abstract concepts, engage students, and ultimately raise educational standards (Ndihokubwayo, Uwamahoro, & Ndayambaje, 2020).

Physics education has used educational software and information and communication technologies (ICTs) because of its capacity to enhance learning outcomes, generate enthusiasm, and simplify abstract concepts. Knowledge transmission and transforming knowledge into a tool for imaginative world exploration are not the exclusive goals of contemporary education. Value orientations, the development of the student's creative potential, and the preservation and enhancement of his personal attributes are highlighted. It is still unclear how to use specialized pedagogical methods to intentionally foster a student's intelligence, creative thinking, scientific worldview, and active life position. This is the main issue with contemporary, creative searches.

The evolution of contemporary education naturally involves innovative procedures. Teachers' and methodologists' searches within the context of traditional education led to their emergence. The results of comparative pedagogical studies demonstrate that, in spite of variations in curricula and school systems, broad concepts regarding the conventional educational process in various nations share characteristics; as a result, common patterns can be found in creative searches. The objective of learning in innovative processes is to give students the chance to master novel experiences founded on the development of critical and creative thinking, and to create the conditions necessary for this growth so that everyone can discover and reach their full potential—intellectual, spiritual, and physical.

New information technologies turn learning into an exciting process, contribute to the development of students' research skills and encourage teachers to master research design techniques. ITFs allow you to individualize the learning process, activate the activities of difficult students in preparing and conducting a lesson. The use of ICT in physics lessons can increase interest in the study of the subject, expand the possibilities of demonstrating experiments through the use of virtual images.

By using ICT in the classroom, teachers can cut down on study time because of its speed and clarity. They can also assess students' knowledge interactively, which improves learning effectiveness. ICT also helps students reach their full potential in terms of their cognitive, moral, creative, communicative, and aesthetic abilities and fosters their information culture and intelligence.

ICTs are employed at various points during the class and for a variety of reasons:

- A visual and illustrative description of the content
- Self-directed learning while denying the instructor's involvement
- Independent study with teacher-consultant’s assistance
- Partial replacement (selective, fragmented usage of extra material)
- The application of training programs
- Utilizing control and diagnostic resources
- Completing creative and autonomous homework
- Calculating and graphing on a computer
- Using software to model experiments and lab work
- Making use of reference and information systems
- Planning the project activities for the students

Although there are numerous potential advantages to using digital educational technology for physics training, there are also certain drawbacks. The requirement that teachers obtain sufficient training in the usage of modern technologies is one of the main obstacles. It's possible that many educators are unaware of the newest digital tools or are unsure on how to successfully incorporate them into their lesson plans. Furthermore, not all pupils may have access to the specific hardware or software needed for some digital technologies.

The possibility that new technologies could worsen already-existing educational disparities presents another difficulty. Lack of access to the newest digital tools may put students at a disadvantage since they would not have the same chances to participate in experiential learning or get individualized feedback and direction.

There are numerous potential advantages to using digital educational technology in physics instruction, such as raising student interest, enhancing conceptual comprehension, and fostering problem-solving abilities. These technologies do, however, come with a number of drawbacks, such as the requirement for teacher preparation, issues with equality and accessibility, and the necessity for ongoing research to fully comprehend how these technologies affect student learning results. We can contribute to ensuring that all students have access to top-notch physics training that equips them for success in the twenty-first century by tackling these issues and utilizing the advantages of these technologies.

The field of physics is constantly evolving from theory to application. Consequently, the lesson can be delivered as a laboratory without offering a direct explanation of the subject, and students can subsequently be asked about the content and its foundation. Students can also be asked to select the instruments they need for the task by arranging them at random on the lab table. With interactive techniques, this approach can be applied in small groups.

## SIMULATION ON A COMPUTER

Computer simulations are particularly useful tools for teaching physics because they allow students to actively participate in rich modeling settings. A plot of energy or a variety of force or velocity vector arrows can be seen in computer simulations. Additionally, while the simulation is running, graphs and vector arrows can be created in real time. However, they can also be paused to enable a stepwise analysis.

According to Sypsas and Kalles (2018), a virtual laboratory is an interactive setting designed for generating and carrying out simulated experiments that lacks actual laboratory equipment. A virtual laboratory is one in which students participate in an activity or experiment that is inherently distant from them or that does not have an immediate physical counterpart. It gives students the equipment and supplies they need to conduct experiments that are stored on CDs or websites (Babateen, 2011). Nedic, Machotkd and Najhlsk (2003) outlined further advantages of virtual laboratories, such as shielding students from potential risks when performing risky lab tests. It helps students and teachers study and prepare laboratory experiments at any time and place; it removes the need to deal with hazardous or radioactive chemicals and other hazards like electrical connections; it allows for the display of very accurate phenomena and results that may not be measurable using simple laboratory tools and that require complex and expensive equipment; and it allows students to repeat the same experiment multiple times based on their capacity to absorb the information.

The student is given the chance to control the experiment's inputs, alter the various transactions, and observe the changes in the results without the presence of a supervisor or any risks, which is typically challenging to provide in a real laboratory when there is a shortage of equipment and limited materials relative to the number of students. For example, a number of research have examined how virtual laboratories affect students' academic performance. Falode and Onasanya (2015) contended that the secondary school physics curriculum should include a virtual laboratory package for Hooke's law, a basic pendulum experiment, and a momentum experiment.

According to a different study by Gambari et al. (2012), students who were taught physics practical's using a virtual laboratory strategy outperformed those who were taught using a traditional laboratory method. In an experimental investigation on the impact of implementing the virtual laboratory approach in physics practical classes, Tuysuz (2010) found that students' abilities, comprehension, and performance had greatly increased.

## CONCLUSION

The use of novel teaching tools in physics classes to adopt a personality-oriented approach to learning is both objectively possible and necessary, as confirmed by innovativeness as the most significant didactic principle.

Information and communication technology (ICT) has a growing impact on practically every aspect of modern life. When properly incorporated into physics education, it helps students and teachers access information more easily, which enhances learning outcomes. Although the use of ICT in teaching and learning is essential in today's classrooms, a number of issues prevent its effective implementation. bad ICT infrastructure, a lack of standard ICT policies, inadequate Internet and network infrastructure, a bad power supply, and a lack of professional development programs are some of the issues that hinder its integration. If the government prioritizes professional development, hosts ICT workshops, seminars, and conferences, provides sufficient resources to secure state-of-the-art ICT infrastructure, and ensures a steady supply of electricity, these problems could be resolved.

All things considered, the goal of using modern technology in the classroom is to teach students how to think logically, to freely express themselves, to evaluate themselves, to work both individually and in groups, and to transition the teacher into a real teaching activity—that is, not to teach the child, but to guide students in their work on learning, mastering knowledge, making them comfortable, easy, and to achieve a continuous improvement of the quality of students' knowledge and the level of their pedagogical skills. Additionally, fast and efficient method selection and application are also important. Hence, the proper use and arrangement of educational technologies in physics classes that focus on generalization and consolidation, understanding of the fundamental laws of nature from a scientific perspective, and the growth of students' proficiency. It educates to systematize the learned knowledge, fosters creative and active youth in the future, and offers a higher degree of logical and creative thinking. It also compares and contrasts natural events.

In summary, physics learning results and student engagement could be greatly impacted by the employment of digital instructional technology. According to the study's findings, using interactive online resources and digital simulations in addition to traditional classroom education can enhance student learning outcomes. Students in the experimental group also expressed greater enthusiasm and engagement in physics and a more favorable attitude toward the usage of digital learning tools.

This study offers insightful information about how digital educational technologies can be used to teach physics, but more investigation is required to determine which technologies work best and how they affect other topic areas. As technology develops more, educators should think about how to harness these developments to improve student engagement and learning. Overall, the study's findings point to the potential for digital educational technology to completely transform how physics is taught and learned.

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India | Thailand | South Korea | United Kingdom
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