

THE INTRODUCTION OF ADVANCED ARTIFICIAL INTELLIGENCE TECHNOLOGIES INTO BIOLOGY

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Abstract: *The article under discussion herein sets out to explore the role of modern technologies in the facilitation of biological education at both the primary and secondary levels. It is important to note that particular attention is paid to multimedia resources, virtual laboratories, mobile applications, and distance learning platforms. These resources have been shown to contribute to improving the effectiveness of the educational process. The utilisation of digital tools has been demonstrated to guarantee accessibility and flexibility in learning, enhance safety during experimental procedures, and augment interactivity and student motivation. The necessity to amalgamate innovative and traditional methodologies is emphasised, with the objective being to achieve an optimal balance between the acquisition of theoretical knowledge and the development of practical skills.*

Keywords: *digitalisation of education; biology; multimedia resources; virtual laboratories; mobile applications; distance learning; innovative technologies; pedagogy; interactivity; educational process.*

The advent of modern technologies has had a profound impact on the educational process, including the teaching of biology as one of the fundamental disciplines. In the contemporary educational landscape, there is a growing emphasis on enhancing the efficacy of learning processes. This pursuit has given rise to the adoption of innovative methodologies, which are underpinned by digital tools and interactive resources.

The following essay will explore the primary domains of technological integration within the context of biological education.

1. Multimedia educational resources. The use of video, animation and infographics allows for the clear demonstration of complex biological processes — from mitosis and meiosis to photosynthesis and ecosystem dynamics. The utilisation of such materials has been demonstrated to contribute to the formation of more solid knowledge, as visualisation facilitates the perception of abstract concepts. An exemplar of this phenomenon is constituted by educational video platforms such as Khan Academy, which facilitate self-paced learning for students.

2. Virtual laboratories. Digital simulators such as Labster or PhET provide the opportunity to simulate laboratory experiments in a safe and controlled environment. This is of particular pertinence to educational institutions that do not have access to full-fledged laboratory equipment. Virtual laboratories facilitate students in the development of practical skills, the cultivation of research aptitude, and the acquisition of experiential knowledge, all

while eliminating the risks and financial obligations associated with traditional laboratory settings.

The integration of contemporary technologies into the domain of biology education has been demonstrated to expand didactic possibilities, rendering learning more interactive, accessible and effective. Consequently, digital tools are becoming an integral part of the educational environment, contributing to the formation of competencies necessary for future scientific and professional activities.

Virtual laboratories offer a number of significant advantages that make them an important element of the modern educational environment.

- The capacity to undertake experiments at any time and in any location ensures that all students, including those in remote or resource-constrained regions, have equal access to practical training.

- In the context of digital environments, the implementation of safety measures is of paramount importance. This is due to the elimination of risks associated with the use of potentially hazardous chemicals and equipment. This approach enables students to master experimental techniques without the risk of exposure to health hazards.

- Interactivity and motivation are pivotal elements in the efficacy of virtual laboratories, which have been shown to enhance the dynamic and engaging nature of the learning process. Students are presented with the opportunity to engage in the modelling of experiments, the analysis of results, the formulation of conclusions, and the development of critical thinking skills, thereby contributing to a more profound comprehension of the subject matter.

Empirical research has demonstrated that the utilisation of virtual laboratories fosters a more robust comprehension of biological concepts in comparison to conventional methods alone. However, the greatest effectiveness is achieved through the integration of both approaches. Real laboratories provide a unique experience of working with samples and equipment, while virtual laboratories expand the range of available opportunities and enhance the educational effect.

Consequently, virtual laboratories do not supplant traditional ones; rather, they serve as a valuable addition to them, forming a comprehensive and modern system of biological education.

3. Mobile applications. Digital applications such as PlantSnap and iNaturalist have been shown to facilitate the study of biology in the natural environment. The provision of opportunities for students to identify plants and animals in real time has been demonstrated to contribute to the deepening of knowledge, the development of observation skills, and the formation of a lasting interest in the surrounding nature.

4. Distance learning platforms. The rapid development of technology has led to a significant increase in the importance of distance learning systems, such as Zoom and Google Classroom. These platforms facilitate effective organisation of the learning process by teachers, providing access to materials and creating a space for interactive communication with students. In light of the evolving landscape of technological advancement, it is reasonable to

hypothesise that such tools will undergo continuous enhancement, thereby expanding the scope of modern educational opportunities.

CONCLUSION

The integration of contemporary technologies into the pedagogy of biology is a pivotal instrument for enhancing the efficacy of educational activities. The effective utilisation of digital solutions necessitates that educators be receptive to professional transformation and the continuous acquisition of novel methodologies. Concomitantly, it is imperative to acknowledge that technologies serve a subsidiary role and are incapable of wholly supplanting conventional modes of education. The task of educators is to establish an optimal balance between theoretical knowledge and practical skills, thereby ensuring the integrity and completeness of the educational process.

Consequently, a balanced integration of innovative and classical approaches serves as a robust foundation for the advancement of biology education, rendering it more adaptable, inclusive, and pertinent to the demands of contemporary society.

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