ARTIFICIAL INTELLIGENCE IN BIOLOGY EDUCATION

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Introduction

Artificial intelligence (AI) in biology education can be defined as the deployment of AI in sections of study that help learners and researchers in their areas of concentration, specifically biological sciences. AI provides ways of efficiently surveying and categorizing biological data, thus allowing the integration of various sub-disciplines of biology and the building of models that may unify what are hitherto disparate interest areas (Webb, 2018; Hassoun et al., 2021). It contributes greatly in assisting learning in science, in teaching, and in demonstrating the scientist-student interactions as pertain to the context of teaching and learning science (Good, 1987; Koć-Januchta et al., 2020). Thus, the prospect of future AI applications in the biology educational process suggests bringing in huge amounts of data. This data can be collected, analyzed, and interpreted to make discoveries of a targeted and non-imaginable nature, and to synthesize new ideas and theories connecting different disciplines. This is true because the effort towards the integration of AI in the biology education calls for a joint effort of both the biological and computational scientists, therefore it is agreeable that integration of the two is widely accepted (Hassoun et al., 2021).

Enhancing Biology Education through Artificial Intelligence

It gives a significant meaning toward the improvement of biology education since AI contributes toward the improvement of research methods and the expansion of knowledge on the associated biological concepts. AI technologies specialized for biology enable the users to assimilate data across the sub-disciplinary domains, which form the basis of constructiveness of the comprehensive prediction models and assisting the targeted and untargeted discoveries (Hassoun et al., 2021). In structural biology, it has become possible to enhance the complicated structure prediction tasks with the aid of AI, as demonstrated by AlphaFold2 (Nam, 2023). Furthermore, the presented AI applications in the learning of science contribute to digital education revolutions, students' experience either as learners or interactants with the AI bots (Koć-Januchta et al., 2020). Due to radical re-implementation, AI helps to explore the principles of intelligence and may affect biological intelligence and society on a large scale (Bayaga, 2023). However, one should be careful to use machine learning in biology for achieving high publishing standards and facilitating the AI future in biology (Crovello, 1974).

Personalizing Biology Learning Experiences with AI

AI can effectively integrate this aspect of biology into the students' learning process by employing AI-based approaches which consider the individual differences of the learners and learning rate, feedback as well as inclusively

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engaging all students (Eden et al., 2024). In the case of education, there are intelligent tutoring systems and other personalized learning platforms. The use of artificial intelligence entails the use of machine learning in determining the most suitable learning approaches to adopt, given the student's background, ability, and preference to increase the chances of positive results at the end of the course (Tiwari, 2023). Thus, AI tools based on large language models generating lessons and materials in different approaches can help teach separate biology topics. These AI tools present multiple-choice questions for effective knowledge checks and contribute to increased study time for the subjects that are challenging for students (Akintande, 2024). In addition, AI-based education tools support the implementation of blended learning in science classes. They utilized educational data mining approaches such as cluster analysis to identify the knowledge clusters of students and hence assist teachers to improve on the way they deliver effective learning to cater for student's diverse needs (Setiadi et al., 2022).

Benefits and Limitations of Incorporating AI in Biology Education

AI can be integrated with biology in numerous ways, including but not limited to the following: improve students' engagement, create unique learning environments as well and create interaction and simulations. AI applications such as ChatGPT can be used to explain concepts taught in class to the students in detail and enhance their comprehension of these biological concepts (Lee, 2023). Moreover, AI can help in anatomy learning in terms of image interpretation and identification of the structures, as well as the acquisition of the anatomical knowledge with the focus on the efficiency of ultrasound in the USG-RA training (Jacobs et al., 2023). However, there are difficulties, for example, in the ethical plane, in the possibility of prejudicial systems of AI or in the necessity of further studies to achieve the best learning results through incorporating AI technologies in biology (Adiguzel et al., 2023). Strategies for overcoming these drawbacks are pertinent in preventing the misuse and inefficiency of AI in fortifying biology knowledge.

Summing-up

AI is a double-edged sword which can pave the way to transform the biology education area by reintegration of the split sub disciplines, data acquisition and analysis, data driven prediction and many other non-imaginable possibilities (Hassoun et al., 2021). Education is among the many industries that have fully embraced the usage of AI technology, as evident from basically all administrative undertakings in schools, use of intelligent Web-based systems, and even humanoid robots (Chen et al., 2020). Furthermore, the role of AI in modern education is observed worldwide, as adjusted and fast solutions enhance students' experience in learning (Sanabria-Navarro et al., 2023). Continued advances in artificial intelligence as a powerful tool in biological research will prove a major boon to the further development of biology education. Traditional basic biological sciences and such interdisciplinary fields as computational biology will step up their cooperation and come up with new theoretical predictions. They develop new theoretical frameworks; all these exciting changes that are rocking the biological world today are destined to reshape the face of the education in biology in the twenty-first century.

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