

INTERDISCIPLINARY APPROACHES IN BIOLOGY CLASSES

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Abstract

Biology is part of the curricular area Mathematics and Natural Sciences and intersects closely with physics, chemistry, biochemistry, geography, mathematics, and computer science, particularly in topics related to medicine, nutrition, and the environment. An interdisciplinary approach to teaching biology offers significant benefits, enriching the learning process and fostering deeper engagement. By integrating knowledge from multiple subjects, educators can increase students' interest and motivation, while also promoting the development of critical thinking skills. This approach enables learners to examine concepts from multiple perspectives and engage in creative problem-solving, especially when lessons draw on content from more than one discipline rather than presenting information in isolation. Linking ideas across fields not only clarifies concepts but also helps bridge the “language” of different school subjects, creating a more cohesive and relevant learning experience.

Keywords: biology; teaching process; interdisciplinary; integrating knowledge; students,

Introduction

The term “interdisciplinary” first appeared in the early 20th century, used by the Social Science Research Council as a bureaucratic shorthand for promoting research that involved more than one discipline (Frank, 1988).

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Interdisciplinarity serves several purposes: *applied* – the transfer of methods for practical applications; *epistemological* – the use of methods from other fields; and *generative of new disciplines* – the transfer of methods between two or more disciplines, which can lead to the emergence of an entirely new field (Nicolescu, 1999).

In the context of the rapid development of the sciences, biology can no longer be regarded as an isolated discipline; it has evolved into a complex field that works in constant collaboration with other sciences. Teachers must experiment with innovative teaching approaches aimed at enhancing students' learning experiences.

Literature Review

Interdisciplinarity in biology is not merely an advantage, but a necessity in today's world. Its implementation in biology teaching is an important pedagogical requirement within the educational process, creating opportunities to broaden students' scientific perspectives.

An interdisciplinary approach eliminates the fragmentation and isolation of informational content during instruction and encourages the development of students' critical thinking skills. The study of complex problems or concepts in biology requires the integration and synthesis of knowledge from physics, chemistry, mathematics, geography, medicine, and computer science (Županec et al., 2022).

Methodology

Interdisciplinarity focuses on the development of transversal skills with greater long-term relevance. In the context of the rapid advancement of the sciences, biology can no longer be regarded as an isolated discipline. It has evolved into a complex field that works in constant collaboration with other sciences to understand and address challenges.

By combining instructional content and working models, students achieve a deeper understanding of the subject matter, which in turn leads to improved academic performance (Labov et al., 2010; NRC, 2003).

Results

There is a correlation between the way teaching activities are conducted and students' performance. The interaction between disciplines should not be limited to the exchange of

information but should also involve the development of working algorithms and the resolution of learning tasks.

The following are examples of interdisciplinarity.

The interdisciplinarity between biology and physics is reflected in the use of physical methods and concepts to study biological mechanisms. Methodologies and hypotheses are interconnected and adapted to develop new tools that enable the investigation of complex topics beyond the scope of a single discipline. Research equipment and analytical instruments relevant to biology also operate on physical principles (Conț, 2022).

Biology relies on observation and measurement. Based on these measurements, modeling and predictions can be made. Physical parameters (such as pressure, temperature, and humidity) are applied in teaching animal physiology, plant physiology, microbiology, and ecology.

The following are examples of physical concepts used in teaching biology. Optical properties, sounds and ultrasounds, the nature of light, radiation and levers are essential in teaching anatomy (Conț, 2022; Hobbie & Roth, 2007). Membrane transport, resting membrane potential, Donnan equilibrium, electrotonus, the generation and conduction of action potentials, osmotic pressure, and the osmotic fragility of red blood cells are applied in teaching animal physiology (Hobbie & Roth, 2007).

Interdisciplinarity between biology and chemistry. Chemistry has made a significant contribution to the development of biology, through the study of the chemical composition of the cell, inorganic and organic substances, their properties, the chemical formulas of hormones, the molecular structure of proteins, carbohydrates, and lipids, their functions within the cell, nucleic acids, Krebs cycle, cellular respiration, protein synthesis, and more.

One of the oldest and most productive interdisciplinary fusions within the life sciences is that of biology and chemistry in the field of biochemistry.

Interdisciplinarity of biology and mathematics. Almost any interdisciplinary approach involves the use of mathematical knowledge. Experimental design means mathematics. At each stage, previously acquired knowledge is used. Statistical processing of data and graphical representations mean mathematics.

Interdisciplinarity between biology and art. Representation through drawing appears to offer strong potential for exploration in teaching. Visual language consists of elements that can be easily associated with mathematical concepts (point, line, shape, volume), physical concepts (spectral decomposition of light), and semantics (meaning, significance, etc.) (Chitia & Indreica, 2018). Demonstrations using drawings aim to help solidify certain concepts.

Interdisciplinarity between biology and technology. Technology is second nature to students (Annetta et al., 2010; Mikropoulos et al., 2003). Online social networks and electronic resources are increasingly used to enhance students' understanding and interest (Musante, 2008). The application of technology in teaching, learning, and assessment includes skills such as navigating the internet for relevant information, using electronic tools for communication, and employing application tools provided by Microsoft Office (MS Word, MS PowerPoint, MS Excel, etc.).

Lessons delivered through AEL, software developed by specialized companies, educational films, experimental modeling, PowerPoint, or other programs are representative examples of using technology in the teaching process. They can be incorporated at specific stages of a lesson, as required by its logic and instructional strategy.

The lesson must be reinvented to achieve its learning objectives. Modern technologies, such as smartphones with their applications, are also excellent teaching tools. These instruments increase students' interest, foster the development of mathematical skills, scientific and technological aptitude, digital literacy, practical skills, social competences, and a sense of initiative and entrepreneurship.

Biotechnology and bioinformatics are emerging disciplines that combine methods from biology, medicine, and computer science to analyze complex data and develop new therapies. These fields illustrate the disappearance of boundaries between traditional disciplines.

Interdisciplinarity between biology and medicine. Biology and medicine are two distinct disciplines, each with its own approaches, values, and outcomes. These disciplines have been interconnected for more than two millennia. While biology provides theoretical foundation, medicine applies it. Interdisciplinarity is not limited to the application of biological knowledge in medicine but also entails active collaboration between the two fields. Without this collaboration, medicine could not advance, and biology could not fully realize its applied potential.

Interdisciplinarity between biology and psychology. Cortical processes can be correlated with psychology and neurobiology.

Interdisciplinarity between biology and geography. Biology and geography are two fields that complement each other in the study of ecosystems, species distribution, the effects of climate change, and the impact of human activities on nature. Biogeography, for example, examines the distribution of species across geographic areas, considering factors such as climate, topography, and ecosystems.

Interdisciplinarity between biology and history. The history of biology is a narrative of the accumulation of knowledge about the living world, from simple observations to complex analyses, with increasingly specialized and interconnected branches.

Interdisciplinarity between biology and Latin language. At first glance, biology and Latin language may seem like two completely different fields, biology belonging to the natural sciences, and Latin to the humanities. However, a closer analysis reveals a deep and intriguing connection between them. Latin language plays an essential role in the scientific naming of plant and animal species.

In recent literature, there is a growing view that the focus should not be on the specific discipline of study, but rather on the system of concepts and methods used to quantitatively describe a phenomenon and to probabilistically predict what will follow (Conț, 2022). The transition to an interdisciplinary approach in education is a long and challenging process.

Discussions and conclusions

The instructional-educational process is an act of creation. A delivered lesson is shaped by scientific content and the specific characteristics of the students. A good lesson is the creation of the teacher, the students, and the atmosphere established in the classroom.

When planning an interdisciplinary lesson, the teacher must consider several factors: the purpose of the lesson, its objectives, the teaching methods, the connections between disciplines, and the extent to which students already possess knowledge related to the subject being studied. This approach allows students to explore concepts from multiple perspectives, engage creatively in problem-solving, express themselves freely, and work either in teams or individually. The aim of the interdisciplinary approach is to dissolve the boundaries between fields of study.

Interdisciplinary education plays an important role as it provides resources for the advancement of science. Fields such as medical physics, biochemistry, computational biology, biomathematics, bioengineering, and physical chemistry are clear evidence of the need for interaction between the sciences.

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