



Methodological Approach to Biotechnology Science

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Abstract: This paper involves the application of new modern methods in teaching biotechnology, the increase in efficiency indicators, the areas in which biotechnology is used, the methods of delivering scientific information about them to students, the connection between biotechnology and genetic engineering, the role of animations in teaching biology, and teaching mechanisms based on educational goals. It also discusses logical thinking, separating substances through computer graphics and delivering them to students.

Keywords: Biotechnology, teaching, field, illustrations, in-depth study, animation, active molecules, a modern multimedia, logical thinking, computer science skills, identifying, connections.

Introduction: Students' mastery of educational material is manifested primarily through the use of methods that encourage interest in acquiring educational information, initiative, independence, and satisfaction with their own activities. To achieve this, problem-based, partially research and heuristic, research, and motivational methods of education are used. The method used should be selected taking into account the conditions and capabilities of the teacher's educational work - the room where the lesson is held and its equipment, the availability of educational tools, hygienic conditions, the season, the composition of the day, the readiness of students to master the lessons, and so on.

The teaching of biotechnology also focuses on the application of modern methods and solving problems of how to deliver innovations in science.

When students deal with Biotechnology in Science or Biology courses at school they get to know a technology that is on the one hand very old – if we think of techniques of making bread or wine – but that on the

other hand - when we think of genetic engineering for example - comprises very new aspects. This “modern” part of biotechnology shows a high potential for solving various problems of our modern world but at the same time it is accompanied by new and especially ethical questions and problems. From the high relevance as well as from the ambivalence of the topic biotechnology a particular responsibility of the science subjects at school concludes. This is the responsibility to – on the one hand - inform the students in a sound way of the scientific and technical aspects of biotechnology and – on the other hand - to qualify them as the decision makers of the future to cope in a reasoned way with the chances and the risks of biotechnology.

As the knowledge in the life - sciences has exploded during the last two decades, for science teachers it is necessary to restrict to the main fields of biotechnology for teaching. However, the central application fields of biotechnology (pharmaceutical industry, medicine, farming, nutrition and environmental technology) as well as the procedures (i.e. genetic engineering, cell culture techniques, cultivation of microorganisms) should be taken into account. Out of the variety of all the procedures that are summarized under the term biotechnology genetic engineering is still one of the most discussed. Especially because of its potential significance for the future in the following the examples for teaching biotechnology will focus on this technique [5].

Theoretical bases and discussion. Programs such as FigTree (phylogenetic Tree editor), Mesquite (Java Comparative Biology program), and Genepop (population genetic analysis) are widely used in biology teaching. Universities are great importance in the use of electronic tools or self-improvement of students. However, we are still in a passive position when using these technologies. The main disadvantages of the computer learning program currently consists of:

despite the fact that it is easy, searching for information, especially if it is hyperlinked, takes a lot of time during the lesson if it is not related to;

sometimes biological errors also occur in real material; illustrations do not always correspond to textual material, etc.

When eliminating such problems, in-depth study and research of sources will be required.

The role of animation in teaching biology is invaluable. As we know, biology is studied by indepth study of the activity of active molecules and particles. Accordingly, a modern multimedia program is unthinkable without computer graphics. The tasks facing students are interesting and often difficult to solve, which requires

increasing educational motivation, developing logical thinking, practicing their own computer science skills and identifying connections with mathematics, using creative opportunities [3].

As a reason for this findings a lack of sound information of the public is seen. As a reaction to this results in several countries of the European Union the topic “Biotechnology” has been integrated into the school curricula. This fact led – among others – to a project called EIBE (European Initiative for Biotechnology Education) that was financed by the European Commission. The aim of EIBE is the information of the public – and of school students in particular - on Biotechnology (Grainger, 1996) [5].

The creation of an environment in which students are best able to learn is of primary concern for any teacher. Regardless of content, good instructors desire to meet the educational needs of their students. While increased understanding and comprehension is always desired, teachers presented with new curricula or content areas are faced with the challenge of delivering and learning the new material, as well as teaching in the most effective manner. Teachers do not often have the time to consider and reflect on the appropriateness of a new curriculum, its content and structure, or instructional strategies for delivery. A call for the inclusion of biotechnology in technology education curricula (ITEA, 2000) raised these challenges for many technology education instructors. Questions about why and how to integrate biotechnology into existing programs will become more prominent in the near future: Why should biotechnology be included in technology education? What is biotechnology? How is the study of biotechnology structured? and What are some appropriate strategies for teaching biotechnology?

Problem-solving Methodology. A problem-solving methodology is a second cognitive element that can be employed in biotechnology education. Familiar to most in technology education, problem-solving often consists of four phases: design, production, evaluation, and presentation. A hallmark of the cognitive learning orientation, the problem-solving methodology focuses on the internal mental processes of the student (Merriam & Caffarella, 1999). Knowles (1984) claims that the problem-solving approach emphasizes the discovery approach of Bruner (1965) by involving three almost simultaneous processes: (1) acquisition of new information; (2) transformation, or the process of manipulating knowledge to make it fit new tasks; and (3) evaluation, or checking whether the way we have manipulated information is adequate to the task (Knowles, 1984, p.25) [4].

Innovation in education can be seen as a new pedagogical theory, methodological approach, instructional technique, teaching tool, or as a theoretical structure that creates a significant change in teaching and learning and that leads to better learning on the part of the students when applied. It is observed that the methods and techniques currently adopted for innovation in science education are integrated into teaching environments with an interdisciplinary approach such as integration of technology in science education, science-technology-engineering-mathematics (STEM), etc. In some studies, game-based learning environments are considered as an innovative teaching approach. It has been stated that game-based teaching will help students to develop technological awareness and to overcome difficulties in their professional development. Lin and Tsai stated that using technology to enhance learning in science education has become an important trend and found that virtual reality, mobile learning, ubiquitous learning, augmented learning and game-based learning approaches are generally used as innovative technologies in science teaching. Similarly, Istance and Kools pointed to the relationship between innovation and technology in education. In another study, the event-based learning approach has been used as a tool for collecting data, evaluating data, proposing innovative ideas and writing to promote students' innovative thinking and entrepreneurship [2].

A lesson on familiarizing students with new material or a lesson on imparting (learning) new knowledge is an educational process that includes a relatively wide range of questions and requires a lot of time to study, the content of which is new material that is unfamiliar to students. In such lessons, depending on its content, clear goals and students' readiness for independent work, in some cases the new material itself is presented. In other cases, independent work of students is carried out under the guidance of a teacher, and in the third case, both are used. The structure of a lesson on familiarizing students with new material: repetition of previous material, which is the basis for learning new material, explanation by the teacher of new material and work with the textbook, checking and preliminary consolidation of knowledge, assigning homework.

Forms of learning new material can be:

- lecture;
- Teacher's explanation with the involvement of students in the discussion of individual issues;
- heuristic conversation;
- independent work with a textbook and other

sources;

- organization and conduct of experiments and experiments.

In the lessons of consolidation of knowledge, the main content of the educational work is to comprehend previously acquired knowledge for the second time in order to consolidate them. Students comprehend and deepen their knowledge from new sources or solve new problems according to the rules known to them, repeat previously acquired knowledge orally and in writing, or provide information on separate issues from them in order to further and consolidate what they have learned. By structure, such lessons provide for the passage of the following stages: checking homework, performing oral and written exercises, checking the completion of the task, giving homework. Lessons on the development and consolidation of skills and competencies are related to lessons on the consolidation of knowledge.

This process is carried out in the course of several special lessons. In other lessons, new topics are continued to be studied. At the same time, at first the children complete the exercise with the help of the teacher and with a serious check of how they understand the task, and then the students themselves determine where and what rules are applied. They must master the application of their skills and abilities in various situations, including in real life.

The main didactic tasks solved in these lessons are:

- systematization and generalization of new knowledge;
- repetition and consolidation of previously acquired knowledge;
- application of knowledge in practice to deepen and expand previously acquired knowledge;
- formation of skills and competencies;
- control of the process of studying educational material and improving knowledge, skills and competencies.

The main forms of this type of lessons are:

- independent work lessons (reproductive type - oral and written exercises);
- laboratory lesson;
- practical lesson;
- lesson-excursion;
- lesson-seminar [1].

While technology undoubtedly has changed education, many educators opt to use a more traditional, low-tech approach to learning.

Here are some examples of low technology usage in different teaching methodologies:

- Kinesthetic learners have a need for movement when learning. Teachers can allow students to move around, speak with hands and gestures.
- Expeditionary learning involves “learning by doing” and participating in a hands-on experience. Students may participate in fieldwork, learning expeditions, projects or case studies to be able to apply

knowledge learned in the classroom to the real world, rather than learning through the virtual world.

- Many types of vocational or practical training cannot be learned virtually, whether it be a laboratory experiment or woodworking Fig.1. [6].

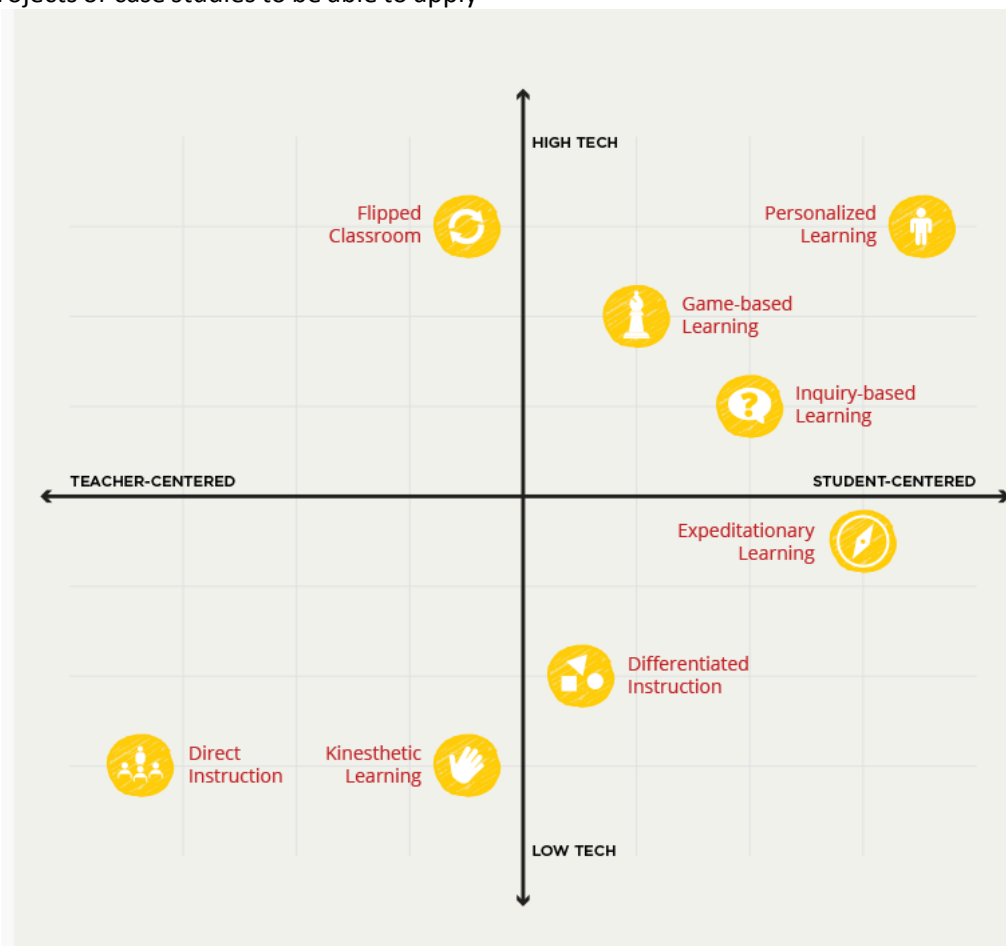


Fig.1. Low-tech approach to learning. <https://teach.com/what/teachers-know/teaching-methods/>

Through these different approaches to teaching, educators can gain a better understanding of how best to govern their classrooms, implement instruction, and connect with their students. Within each category of teacher and student centeredness and tech usage, there are specific teaching roles or “methods” of instructor behavior that feature their own unique mix of learning and assessment practices.

CONCLUSION

Based on the above considerations, it can be said that in teaching biotechnology, a harmonious combination of methods is very important for effectively achieving educational goals and developing in students the skills necessary for successful adaptation to modern society. In today’s educational environment, various teaching methods play a crucial role in creating an effective learning environment.

Traditional methods such as lectures and labs are standard components of the educational process. Lectures provide students with basic information, while labs help consolidate the knowledge gained. With the development of educational paradigms, there is an increasing emphasis on interactive methods. Group discussions, project assignments, and role-playing games are actively introduced into the learning process. These methods help develop students’ active participation, communication skills, and teamwork.

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