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## Advantages of STEAM Technology in Teaching Practical Lessons in Biology

### Abstract

Science and STEAM integration bring together a variety of disciplines to promote a holistic approach to problem-solving and learning. This integration not only increases the depth of understanding in each area, but also prepares individuals to solve complex problems using a variety of approaches. One of the preferred methods for the STEAM teaching model is the use of E-learning models, which are ways to apply constructivist learning theory in the classroom. E-learning models - Constructivism is based on the application of inquiry learning and conceptual change. E-learning models are being updated and developed rapidly. When teaching practical lessons in biology, STEAM technology can be used to set problems in various ways.

1. Discussion of the problem, 2. Familiarization with visual information, 3. Tables for studying the problem, 4. Study of the topic.

**Keywords:** *biology, technology, STEAM, method, practical*

### Introduction

The multidisciplinary approach of STEAM (science, technology, engineering, arts, and mathematics) offers solutions to many of the challenges facing humanity. Combining these fields of study opens up a variety of opportunities, from applying scientific discoveries to solving real-world problems to creating visually appealing designs. The main component of this STEAM subject combination is biology. The basic ideas of biology, derived from the study of natural systems and living things, are applied in many academic fields and help generate original ideas.

The combination of biology with STEAM subjects can produce innovative and effective results in various fields. For example, in the field of bioengineering, new technologies can be developed by taking inspiration from the structures of biological organisms. By studying the aerodynamic structure of bird wings, more efficient airplane wings can be designed. Together with engineering principles, this design process can help develop new materials and promote innovations in the aerospace industry. The integration of biology with STEAM subjects can also lead to interesting results in the field of art. For example, artists can interpret biological concepts to create visual artwork. Works such as medical illustrations depicting cellular processes or sculptures of biological forms enhance the aesthetic interpretations of scientific knowledge (Lindsay, 2021, e12327).

### Research

Setting problems with STEAM methodology in secondary school textbooks can be done in different ways.

1. Problem discussion: Discussing the problem with students to start the lesson. This will help students understand the importance of the problem and share their thoughts on the topic.

2. Visual information introduction: Special materials can be provided to students to familiarize themselves with the problem through visual information, videos, figures or infographics. This will help them to study the problem more closely and increase their interest in the topic of the problem.

3. Problem research schedules: Students are given time to research a specific problem and develop plans for its solution. This provides an opportunity to express their ideas, collect information to investigate the problem and propose various creative solutions.

4. Topic study: Students are given the opportunity to collect and discuss information from various sources to learn more about the topic of the problem.

This is an important step in developing your own ideas and finding ways to solve the problem. Investigating local ecosystems or organizing field expeditions. This is an opportunity for students to observe the beauty of nature, increase their sensitivity to the environment, and think creatively about ways to solve problems (Chistyakov, Zhdanov, Avdeeva, Dyadichenko, Kunitsyna, Yagudina, 2023, em2256).

Currently, STEAM lessons are taught to students in secondary schools starting from the 5th grade, twice a week. If we look at the topics in the curriculum, we will see that the lessons become more complex as the grades go by, and topics that will attract the interest of the students are taught, taking into account their age category (Anwar, Bascou, Menekse, Kardgar, 2019, 2).

For example, let's look at the curriculum designed for 9th grade:

- ✓ Analog devices (Potentiometer)
- ✓ Parking radar system (Ultrasonic sensor)
- ✓ Coded box evaluation
- ✓ Rescue drones
- ✓ Tactical unmanned flight
- ✓ 3D modeling and mapping

When conducting practical experiments in biology, the ability to first collect data and use STEAM technology equipment increases the quality of the lesson. For example, by giving an example related to plant growth, they can test the effect of different soil types or irrigation methods on plant growth. During these experiments, they collect data and analyze this data (Utomo, Hasanah, Hariyadi, Narulita, Umamah, 2020, p.463-476).

This is an example of STEAM methodology in biology lessons.

Experiment: Study the effect of different soil types and irrigation methods on plant growth.

Objective: Different soil types and irrigation methods affect plant development.

Experiment progress:

1. Two different soil types are selected for the experiment (for example, clay soil and sandy soil).
2. Two different irrigation methods are determined for each soil type (for example, regular irrigation and drip irrigation).
3. Plant seeds (for example, beans or wheat) are sown for each combination.
4. At the beginning of the experiment, the growth conditions (light, temperature, etc.) of each group of plants are equalized.
5. Soil moisture is measured regularly throughout the growth process of the plants.
6. At the end of a specified period (e.g. 4 weeks), the growth status and yield of the plants are recorded.

Data collection and analysis:

1. Growth indicators such as plant size, number of leaves, flowering or fruiting status are recorded.
2. The effect of soil moisture and irrigation methods on plant development is observed and recorded.
3. The data obtained are evaluated by statistical analysis.
4. The effect of different soil types and irrigation methods on plant development is evaluated comparatively.

Results:

- The effect of different soil types and irrigation methods on plant development is determined.
- The most suitable soil-agricultural relationship and irrigation method are determined.
- The correctness of the hypothesis is assessed.

These experiments allow students to use both theoretical knowledge and practical skills together. They also give students experience in the processes of collecting and analyzing data, applying the scientific method, and interpreting results. These experiments also develop students' critical thinking skills and help them understand the scientific research process.

## Conclusion

The benefits of teaching biology with STEAM techniques can lead to innovative and creative results in various fields. For example, in the field of bioengineering, new technologies can be developed by taking inspiration from the structures of biological organisms. By studying the aerodynamic structure of bird wings, more efficient airplane wings can be designed. This design process, combined with engineering principles, can help develop new materials and drive innovation in the aerospace industry. The necessity of using STEAM methodology in biology lessons is that it allows students to deeply understand and apply information, rather than simply memorize it (Jesionkowska, Wild, Deval, 2020, p.135). This approach helps students develop their skills in understanding and solving real-world problems. The integration of biology with STEAM subjects can also lead to interesting results in the field of art. For example, artists can interpret biological concepts to create visual works of art. Works such as medical illustrations depicting cellular processes or sculptures of biological forms enhance the aesthetic interpretation of scientific knowledge. When applying STEAM methodology to biology lessons, students can create, connect, compare, etc. It is important to focus on the right problem setting to build skills. By engaging in literature reviews, laboratory experiments, or field studies, students develop the skills and confidence needed to become independent researchers and critical thinkers in the field of biology. The application of STEAM methodologies is an effective way to offer students the opportunity to engage in project-based learning, to deepen their understanding of biology concepts, and to develop critical thinking and problem-solving skills. Projects allow students to explore topics of interest in depth, apply their knowledge to real-world problems, and develop practical skills that are essential for success in both academic and professional settings (Herro, Quigley, 2017, p.416-438). STEAM projects often culminate in the preparation and presentation of reports or presentations to communicate the results to others. This component of the project helps students develop communication skills, critical thinking, and the ability to effectively communicate complex scientific ideas to a variety of audiences. Overall, projects and applications offer students valuable opportunities to engage in hands-on learning, apply their knowledge to real-world problems, and develop skills essential for success in biology and beyond. Through experiments in STEAM classes, students gain hands-on experience in scientific inquiry, data collection, and analysis, while also developing laboratory skills and techniques (Juškevičienė, Dagienė, Dolgopolovas, 2021, p.209-228).

By incorporating STEAM elements, educators can create more engaging and interactive learning experiences that encourage interdisciplinary exploration and innovation. In addition, we discussed various ways to teach STEAM methodologies in biology classes, emphasizing the importance of hands-on activities, project-based learning, and collaborative projects. These approaches deepen students' understanding of biological concepts while also developing key skills such as problem solving, creativity, and teamwork.

A pedagogical experiment conducted as part of this study provided valuable insights into the effectiveness of STEAM-based instruction in biology education. The results indicate that students who participate in STEAM-oriented activities demonstrate greater enthusiasm, engagement, and retention of knowledge compared to those in traditional classrooms.

In conclusion, integrating STEAM methodologies into biology classes is essential to prepare students to thrive in a rapidly changing world. By adopting innovative teaching approaches and developing a holistic understanding of science, technology, engineering, arts, and mathematics, teachers can help students become lifelong learners and solve complex real-world problems.

1. The necessity and importance of STEAM methodology in biology lessons are emphasized, and how the application of this methodology can enrich the teaching process is clarified.

2. The problem statement in the methodological literature is refined and existing research on lessons designed to teach biology lessons in accordance with the STEAM methodology in universities and secondary schools is analyzed in detail.

3. Methods and practical issues of teaching STEAM methodology in biology lessons are also evaluated, and research is worked on.

4. STEAM teaching involves students in the process of solving problems and coming up with new ideas by supporting their creativity and innovative thinking.

5. It allows students to apply their scientific knowledge in practice by learning the principles of research and observation.

6. STEAM methodology enables students to express their own ideas and be guided by their own thoughts.

7. STEAM teaching in biology classes helps students to master lectures and increase their research experience.

8. STEAM methodology helps teachers to arouse interest in other areas in biology classes, so that students become interested in various scientific issues and have a wider spectrum of knowledge.

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