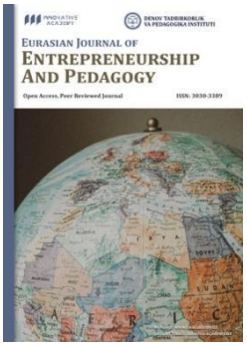

IMPROVING THE QUALITY OF PRACTICAL EXERCISE IN BIOLOGY TEACHING METHODOLOGY LESSONS

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ABSTRACT

This article explores innovative approaches to organizing practical sessions within the "Biology Teaching Methodology" curriculum. As traditional teaching methods prove insufficient in developing the professional competencies of future biology teachers, the scientific necessity of implementing specific interactive methods is established. During the research, a concise scientific analysis was conducted on the impact of interactive techniques such as "Insert", "Venn Diagram", and the "Silent Table" method on students' academic achievement levels. Mathematical-statistical calculations were performed based on the data obtained from the group utilizing these methods. The research results indicate that the acquisition coefficient in the experimental group reached K = 1.35, marking a significantly higher performance compared to the control group. The article concludes with scientific proposals and recommendations for integrating graphic organizers and visual tools into the educational process. These research findings serve as a vital scientific foundation for practical coursework in biology education methodology.

INTRODUCTION

Today, the formation of professional competencies of future biologists in the world education system, especially the correct establishment of natural science teaching methods, is becoming a requirement of the times. Research shows that the process of teaching "Biology Teaching Methods" in higher education institutions requires not only providing students with theoretical knowledge, but also practical skills and analytical thinking in students [1]. However, traditional teaching methods are often limited to conveying. Practical lessons,

however, do not provide students with the ability to analyze the topic in depth as a result of standing at the blackboard and asking questions [2].

In order to overcome this problem, the full introduction of graphic organizers and interactive methods into the teaching process is of great importance. In particular, the “Insert” method serves to sufficiently improve students’ skills in working with text, sorting information, and critical analysis.

The methodology of teaching natural sciences through global problems is based on various methods, for example, PBL. These methods identify students' competencies such as problem identification and hypothesis generation [3].

Methods that can be used based on a creative approach include interactive methods, project-based situations, the STEAM approach, and information technologies. It allows teachers to develop methodological recommendations for using creative methods in the lesson process [4]. In order to increase the activity of future teachers, it is advisable to use various didactic methods in the lesson process.

When comparing biological objects and processes, it is advisable to reveal their similarities and differences through this method. Also, the “Dumb Table” method helps to significantly increase students' ability to think freely and remember. The inherent complexity of biology textbooks is that they consist of many terms, drawings, and interconnected micro- and macrosystems. To make these processes understandable and interesting to students, lessons should be organized in an innovative way. In the figure below, the topic “Biology teaching methods based on Venn diagrams using the methods “Insert”, “Venn diagram”, “BBB”, “Silent table”, “Brainstorming”, “Case study” and “PPP” is very useful in explaining, for example, the topic 5 “Creating a technological map of lessons”. During the explanation of the topic, it is also possible to highlight the similarities and differences of these methods.

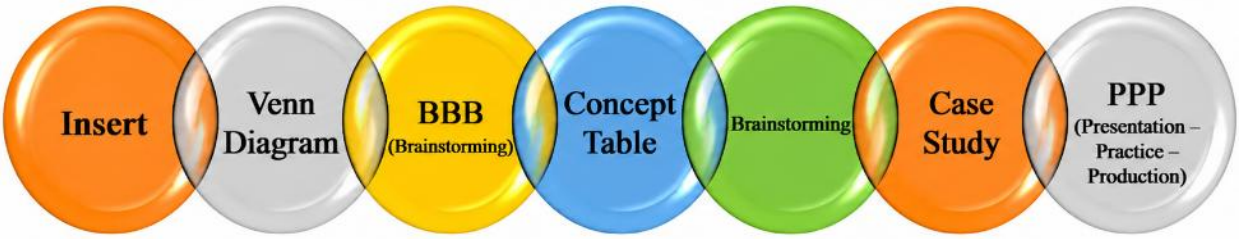

Figure 1. 7-circle Venn Diagram used to create a technological map of lessons

This figure shows different versions of a Venn diagram. This method can be used to illustrate the similarities and differences between other methods. The similarities and differences between these methods can also be highlighted during the explanation of the topic.

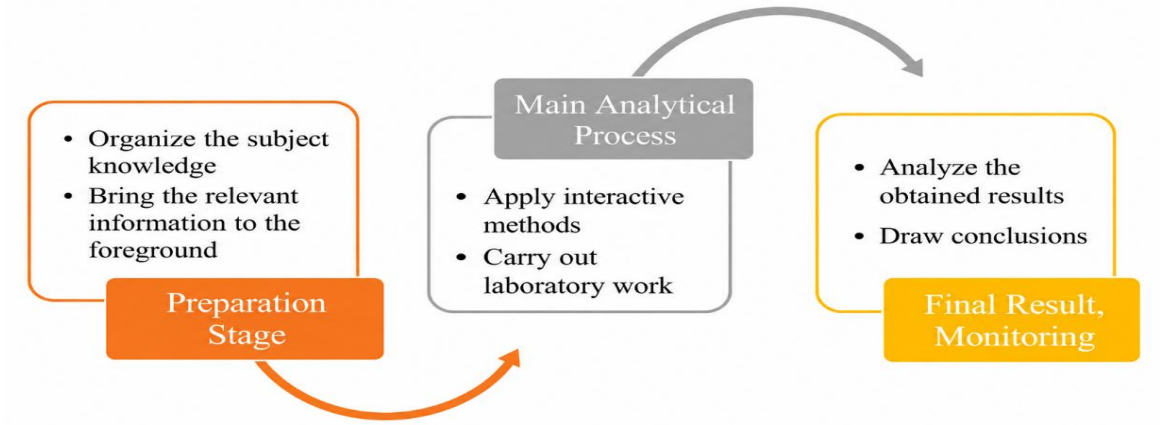

Figure 2. Logical stages of using innovative methods in biology practical classes

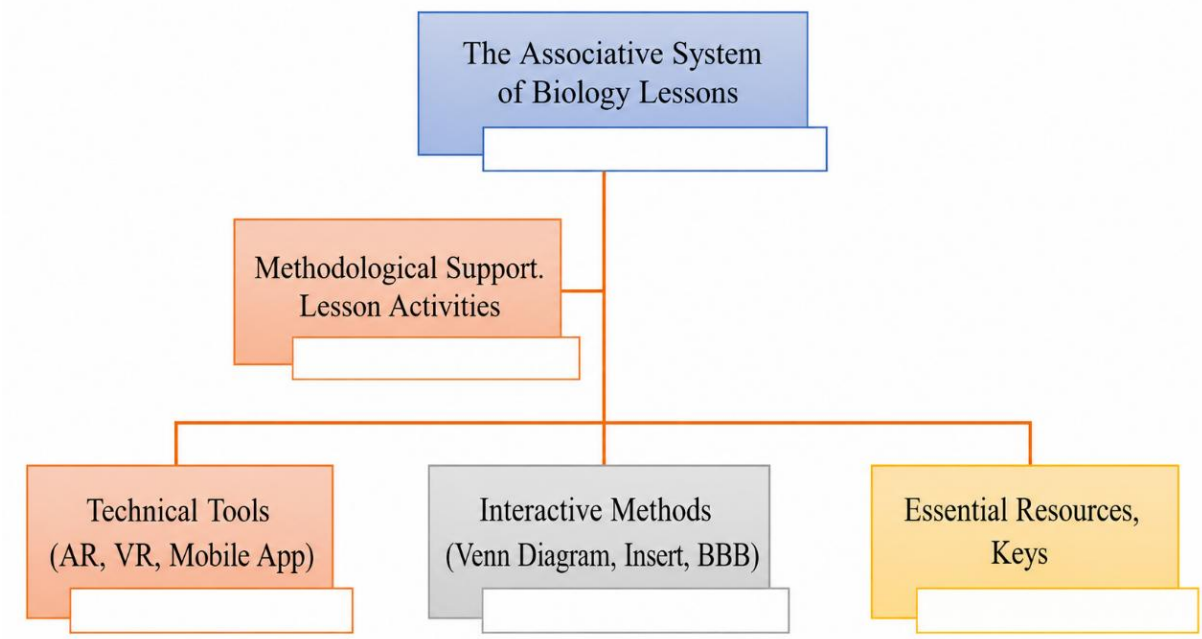

Figure 3. Components of an innovative environment in biology lessons

The second and third figures above depict a roadmap for organizing biology lessons. Improving biology lessons requires not only the use of a single method, but also a systematic organization. In particular, as shown in picture 3, technical tools and interactive methods are very useful for improving the quality of lessons. In Finnish education, “Outdoor education” is widely used in biology based on various approaches. The goal is to organize lessons in harmony with nature. Or, in Japan, biology is integrated with other subjects based on the STEAM model, and students are involved in developing scientific projects.

LITERATURE ANALYSIS AND METHODOLOGY

Based on international experience, the “Inquiry-based learning” methodology is widely used in the mutual study of practical lessons in biology, especially in the United States. Studies show that when lessons are conducted using different methods, educational effectiveness is also at a high level [5].

In foreign countries, the “Puzzle” methodology is very useful for organizing lesson processes in an interesting way, in which students are divided into small groups and each of them studies a separate topic [6].

In order to develop students' independent thinking and analytical skills in biology lessons, the following interactive methods were tested in experimental and test processes.

“Insert” method. Students classified information in the process of reading a text on a new topic (for example, “Cellular Genetics”).

This method has been shown to develop students’ skills in analyzing information [7].

“BBB” method. It has been shown that using this method at the beginning and end of practical classes allows students to determine their dynamics during the lesson.

“Venn diagram” method. Researchers have proven that students have a visual method of comparing two or more biological concepts [8].

“Brainstorming” and “Dumb Table” methods. They were used to increase students’ creative thinking. Through the “Dumb Table”, students independently performed the sequence of biological processes. Researchers have noted that methodologies play an important role in practice-based biology and are very useful for students, for example, in understanding complex topics in biology [9].

In European countries, modern technologies play a significant role in interactive teaching of biology. For example, through platforms such as Biology interactive simulations, Google classroom, Khan academy, Kanhoot, Wordwall, students can learn independently [10].

RESULTS

During the research process, methods such as “INSERT,” “Venn Diagram,” and “BBB” contributed to simplifying and mastering complex topics in the methodology of teaching biology. In particular, the “Silent Table” methodology increased students’ independent learning activity and enabled them to systematize theoretical knowledge in practice. This, in turn, positively influenced the learning achievement coefficient. The results in the groups where interactive methods were applied were distributed as follows:

When the “Venn Diagram” and “INSERT” methods were applied, students’ ability to logically relate the topic increased by 28%.

In assessment tasks conducted using the “Silent Table” method, students recorded information more accurately due to visual memory, with the number of errors decreasing by 1.5 times.

Mathematical analyses (K = 1.35) indicated that these results were achieved precisely due to the integrated application of the above-mentioned methods.

Below are the analytical results of the experimental trial activities.

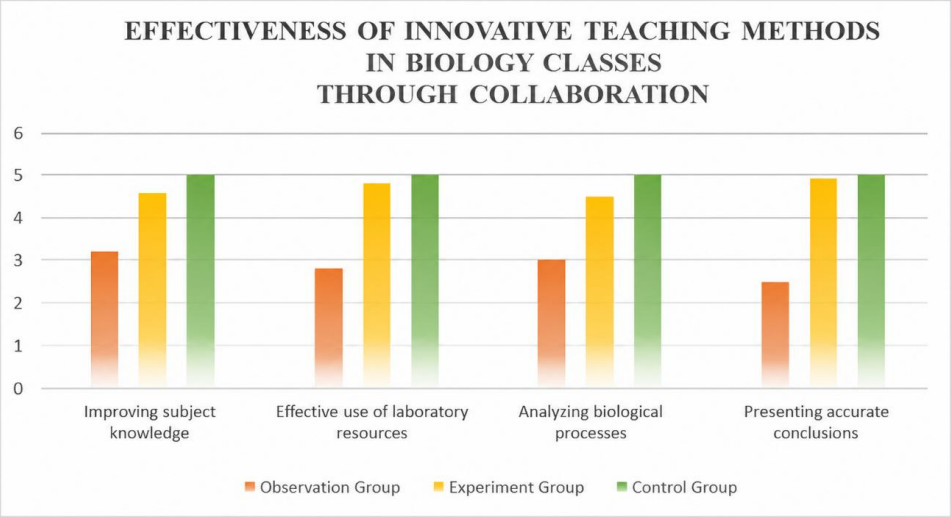

Figure 1. Comparative analysis of the practical skills of students participating in the study based on criteria

This questionnaire revealed that the results in the control group were around 2.5-3.2 (average), and in the experimental group - 4.5-4.9 (high). The results show that while the level of interactivity of students was low in the traditional teaching method, after using the "Insert", "Silent Table", "PBL" methods, this indicator was 4.9 points. This indicates that the proposed methodological model provides more than 90% efficiency in biology practical classes.

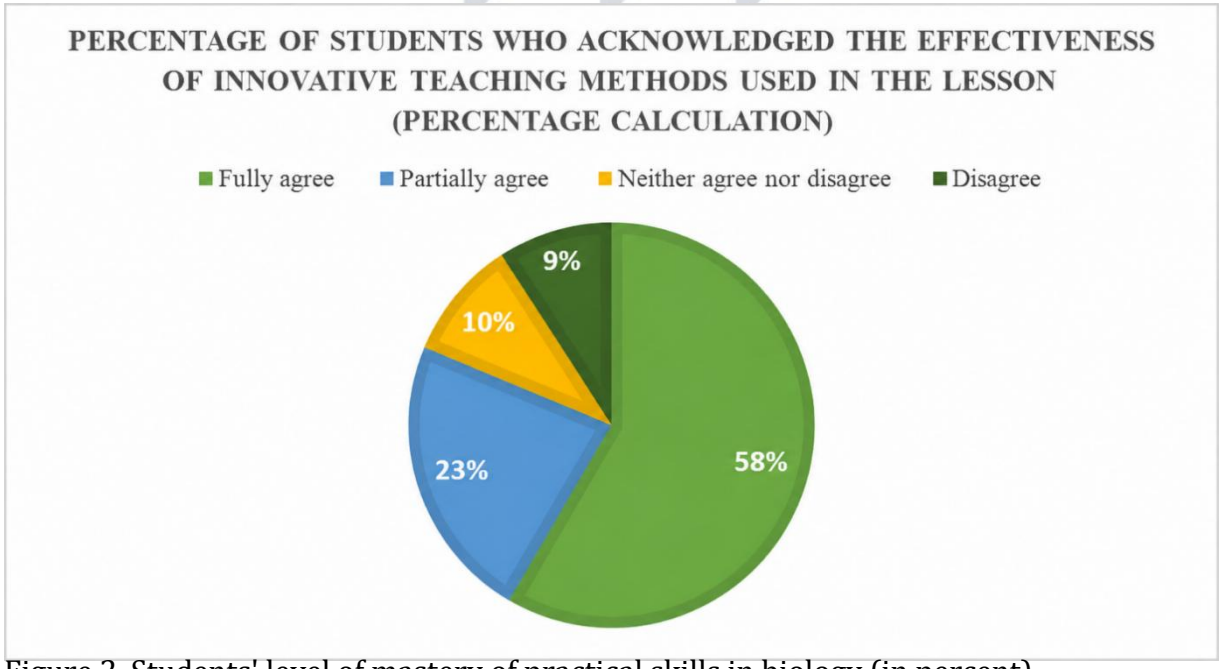

Figure 2. Students' level of mastery of practical skills in biology (in percent)

According to the research results, it was determined that the majority of students, namely 58.8%, fully mastered the topic. After the implementation of the innovative approach, 22.9% of students demonstrated complete mastery of the educational material. The proportion of students who experienced difficulties in explaining the topic showed the lowest indicator at 8.6%, which proves the high effectiveness of the proposed methodology.

When the obtained results were subjected to mathematical-statistical analysis:

Experimental group: $X_{exp} = 4.6$

Control group: $X_{con} = 3.4$

When expressed using the formula:

$$K = \frac{4.6}{3.4} = 1.35$$

The pedagogical effectiveness coefficient was determined as $K = 1.35$. This indicates that the proposed innovative methodology increased the learning achievement rate by 35% compared to the traditional teaching method.

When the obtained results were verified using Student's t-criterion, the reliability of the differences was confirmed at the 0.95 probability level.

When tested according to the Student's t-test formula:

$$t = \frac{(4.6-3.4)}{\sqrt{\frac{0.5}{30} + \frac{0.6}{30}}} \approx 4.2$$

Since the calculated value $t_{empirical} = 4.2$ was greater than the critical value $t_{critical} = 2.04$ given in the table ($p<0.05$), the differences were considered statistically significant rather than random.

Below, Table 1 presents the table of average indicators.

Table 1.

Analysis of student learning outcomes in the experimental and control groups.

Indicators	Control group (n=30)	Experiment group (n=30)	t-criterion	p-qiymat
Average score $(\overline{X})$	3,4	4,6	4,2	$< 0,001$
Mastery (%)	68 %	92 %	-	-

As can be seen from this table, students in the experimental group achieved higher results than the control group on all criteria. In particular, there was a significant increase in the level of mastery of practical skills.

CONCLUSION

It is advisable to organize practical classes in the subject "Biology Teaching Methods" in higher educational institutions based on interactive methods. Traditional teaching methods play an important role in developing the skills of future specialists in critical thinking, analytical comprehension, creative thinking, memorization and working with visual information. The use of modern interactive methods in biology lessons plays an important role in improving the quality of the educational process. These methods not only organize the process of acquiring knowledge for students in an interesting way, but also develop their

critical and creative thinking skills. As a result of the constant use of interactive methods in teaching biology in modern educational conditions, students' activity increases, interest in experimental activities increases, skills in using technologies are formed, teamwork skills, including speaking skills, thinking skills, self-control and similar skills are formed.

The introduction of graphic organizers such as “Insert”, “Venn Diagram”, “Dumb Table” into the teaching process creates a basis for students to systematically perceive complex biological concepts. The results of mathematical and statistical analysis (Student's t-criterion 4.2 and efficiency coefficient K = 1.35) scientifically substantiated that the level of mastery in the experimental group was significantly higher than in the control group.

RECOMMENDATIONS AND SUGGESTIONS

The “Silent Table” method should be regularly used in biology teaching methodology classes to reinforce theoretical knowledge.

It is advisable to apply the “Venn Diagram” method during practical lessons in order to improve students’ skills in comparative analysis of the similarities and differences among species.

In developing textbooks and teaching manuals on biology teaching methodology intended for higher educational institutions, it is necessary to expand the use of graphic organizers and independent study task sections.

If the subject “Methodology of Teaching Biology” is organized on the basis of digital technologies, both the quality of education and students’ academic achievement indicators will significantly improve.

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