Acta Scientifica Balcanica, **2024, 5(2)**
DOI: 10.63356/asb.2024.001 **UDC 53:[371.314.6+371.311.4**
Short communication

GROUP AND FRONTAL FORMS OF TEACHING PHYSICS – A COMPARATIVE STUDY

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Abstract

This paper presents research results based on different methods of teaching physics to middle school students, with a specific focus on comparing frontal instruction with group work organization. The research was conducted among second-year students attending the "Gimnazija Banja Luka" grammar school located in Banja Luka, during the 2023–2024 academic year, as part of lectures on the detection and effects of ionizing radiation. The goal of this research was to compare the results of students who attended classes taught through frontal instruction with those of students who participated in organized group work. The research results indicate that students who attended classes taught through frontal instruction were more successful and demonstrated greater knowledge on final tests related to the subject. It is concluded that frontal instruction is more efficient and successful in achieving the expected learning outcomes, while recommending different teaching approaches based on students' prior knowledge of the subject and individual characteristics in order to achieve better results. Further research is recommended to improve course materials and enhance knowledge acquisition among students.

Key words: physics teaching, frontal instruction, group work, learning outcomes

INTRODUCTION

The key aspect of creating learning opportunities for students and achieving expected educational outcomes lies in the teacher's approach to course preparation and presentation. Forms of work and teaching methods serve as regulators of the teaching process and are often the focus of research in educational sciences due to their importance in optimizing learning outcomes. It is particularly important to investigate the forms of education that yield the best results. The most effective teaching methods are often verbal, involving monologic and dialogic approaches, which are most commonly delivered through frontal instruction.

The choice of methods and forms of work depends on the characteristics of the students and the type of lesson. Frontal instruction is typically preferred when introducing new material that is unfamiliar to students (Maksimović and Stanić, 2012). Although frontal instruction

allows for a more systematic teaching process, it can sometimes place students in a passive role while acquiring new knowledge (Piščak, 2023).

On the other hand, group work, where the teacher acts as a coordinator, encourages students' independent work and their socialization, but requires a special organization and is not applicable to all types of materials. The shortcoming that appears here is the partial study of the material, so it is sometimes difficult to see the whole of the studied topic (Nešić, 2015). Despite these advantages, research indicates that various teaching methods are still underutilized (Števanić-Pavelić and Vlasac, 2006).

The goal of this research is to compare frontal and group forms of teaching physics and their different impacts on students' development, learning, and academic performance. Although group work is often the primary method of instruction, there is evidence that frontal instruction can be equally effective and may lead to improvements in students' final results (Dubljanin, 2010). Teachers emphasize that the choice of teaching method is the most important factor in encouraging student creativity (Dubovicki and Omićević, 2016). Our educational system is predominantly based on the philosophy of knowledge transmission, where the teacher assumes the role of the primary source of information, which students are expected to absorb and later reproduce (Maksimović and Stanić, 2012).

MATERIALS AND METHODS

The research was conducted in Banja Luka during the 2023-2024 school year, with the respondents being second-year students from the "Gimnazija Banja Luka" grammar school, sociolinguistic major (classes II8, II9, II10, and II11). The aim of the research was to compare the effectiveness of frontal and group teaching methods, with a focus on the topic "Detection and Effects of Ionizing Radiation" A total of 91 students participated, with 47 students (51.65%) from classes II8 and II11 attending lessons in a group setting, while 44 students (48.35%) from classes II9 and II10 were taught using frontal instruction. By the end of the first semester, the average grade for physics class was: II8 – 3.22, II9 – 3.39, II10 – 3.20, and II11 – 3.72. All students used the prescribed textbook of the Ministry of Education and Culture of the Republic of Srpska, with additional material provided by the professor.

Students who attended the "Detection and Effects of Ionizing Radiation" lesson through frontal instruction followed the professor's lecture, while students in the group setting were divided into four groups based on their average grades from the first semester. This ensured that each group had an evenly distributed range of academic performance.

Each group was assigned a specific topic from the lesson to research and present:

- Group I: Geiger-Müller counter
- Group II: Interaction of radiation with matter and the quantities used to describe the effects of radiation
- Group III: Dosimeters and the effects of radiation on living organisms
- Group IV: Protection against ionizing radiation

Each group presented their conclusions to the class, using notes written on the board. Every member of the group was required to actively participate in the presentation.

In the final five minutes of the lesson, students completed a brief assessment, answering five questions based on the unit and aligned with the learning outcomes prescribed by the Pedagogical Institute of the Republic of Srpska (RPZ). The purpose of the assessment was to

evaluate how well students understood the key concepts outlined in the learning outcomes. The questions were as follows:

1. On what principle is the operation of the Geiger-Müller counter based?
2. How is the absorbed dose defined, and in what unit is it measured?
3. What measures are taken to protect against radioactive radiation (α, β, γ)?
4. What is one positive application of radiation?
5. How does radioactive radiation (α, β, γ) affect living organisms?

Students wrote their first and last names, class, and students who participated in group work also included their group number. This allowed for an analysis of how effectively each group prepared and understood both their own material and the presentations of other groups.

RESULTS AND DISCUSSION

The results of the test after covering the teaching unit "Detection and Effects of Ionizing Radiation" revealed significant differences between students who participated in group work and those who were taught using frontal instruction. The detailed results are displayed in Figures 1- 4.

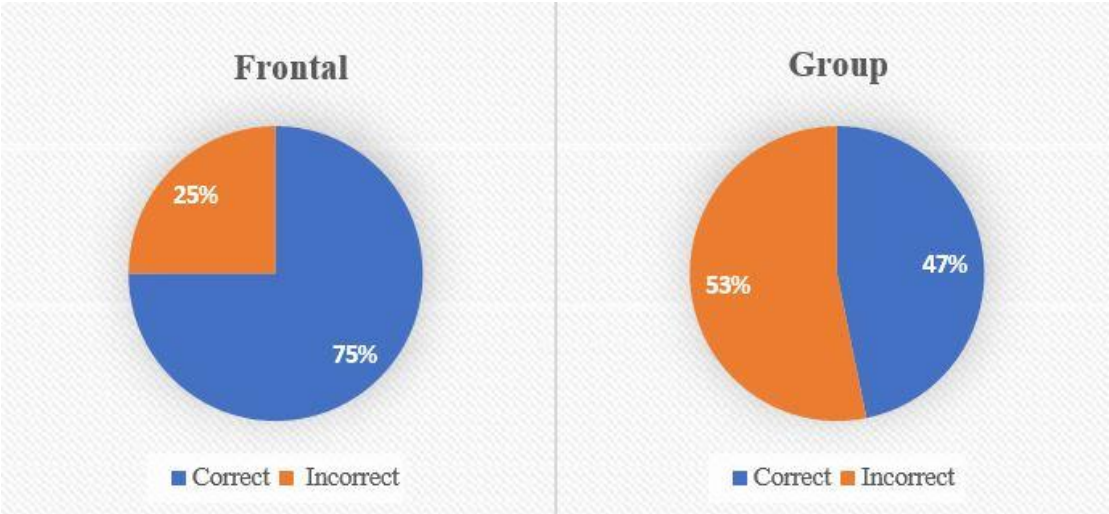

Figure 1. Student responses to the question: On what principle is the operation of the Geiger-Müller counter based?

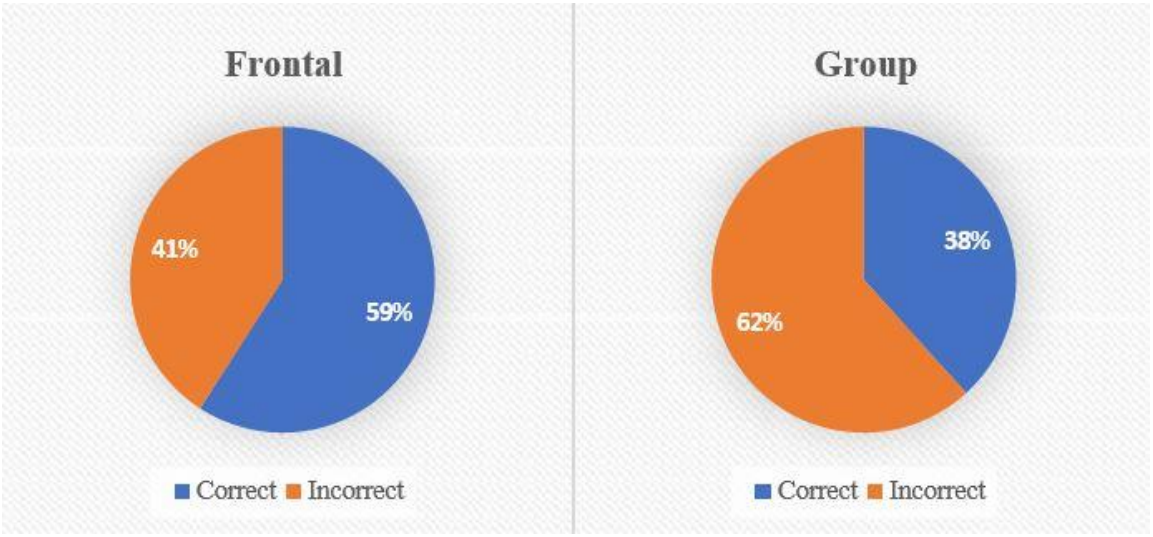

Figure 2. Student responses to the question: How is the absorbed dose defined, and in what unit is it measured?

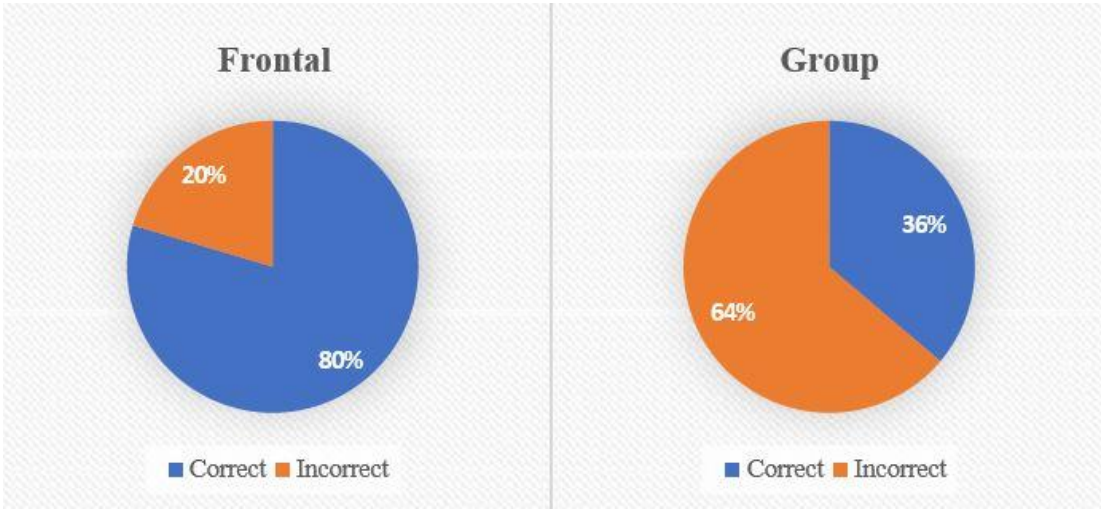

Figure 3. Student responses to the question: What measures are taken to protect against radioactive radiation (α, β, γ) ?

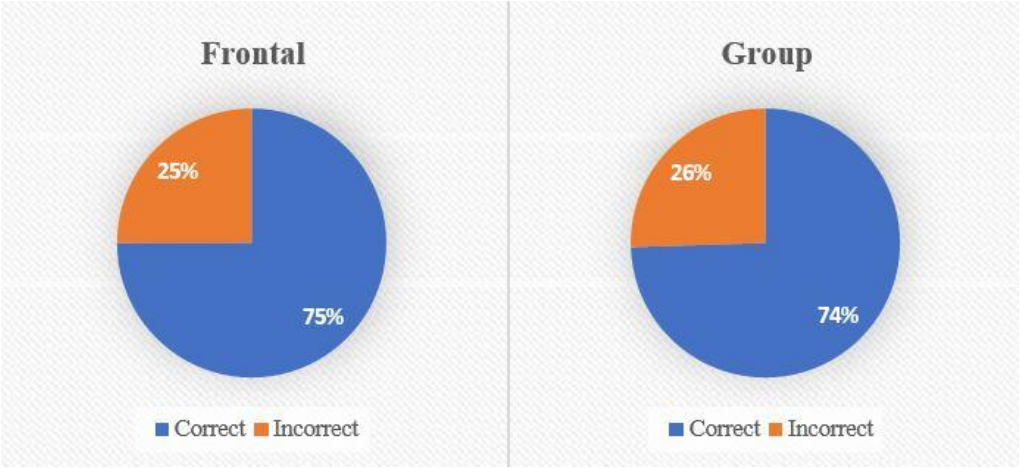

Figure 4. Student a responses to the question: What is one positive application of radiation?

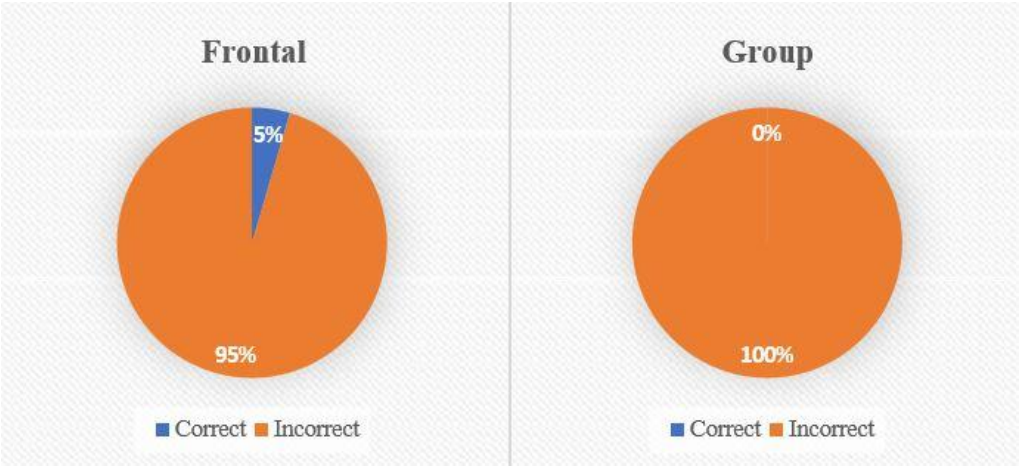

Figure 5. Student responses to the question: How does radioactive radiation (α, β, γ) affect living organisms?

The presented results show that students who engaged with the "Detection and Effects of Ionizing Radiation" unit through frontal instruction achieved better results on most questions compared to those who worked in groups. The exception was the fourth question, where the results were nearly equal between the two groups. On the fifth question, both groups performed poorly, although two students from the frontal instruction group answered correctly, while none of the group work students provided the correct answer.

Among students in the first group, exactly 81.8% of them gave the correct answer to the question related to the part of the class that those students were representing, while only 29.4% of students that were listeners at that time gave the correct answer related to the presented topic. Students from the second group scored 50% of correct answers to the question related to the topic they were presenting, while others who only listened to the presentation scored 21.6% correct answers. Students who were part of the third group scored 10% of correct answers, as well as students who were not a part of this group. As for students in the fourth group, the correct answer was provided by 63.3% of the students that were presenting, and 33.3% of the correct answers were provided by the students not part of the group. As was expected, students who studied, prepared, and presented the topic answered correctly more often than students only listening to the class being presented.

When analyzing the results, it is clear that the percentage of correct answers was higher across all questions in the frontal instruction group compared to the group work method. Based on this research, we can conclude that frontal instruction appears to be more effective than group work for this particular teaching unit.

It is important to note that the success of students in the frontal instruction group was likely influenced by the teacher's preparation and the clarity of the lesson delivery.

The last question had the lowest percentage of correct answers overall, with 0% correct answers in the group work format. This may be due to the question being insufficiently clear. The teacher intended for students to explain the effects of each type of radioactive radiation (α, β, γ) on living organisms, but most students instead described the general consequences of exposure to these types of radiation. Only 5% of students from the frontal instruction group answered this question correctly.

CONCLUSION

The conclusions of the research indicate the advantage of frontal instruction in terms of efficiency, but also emphasize the importance of combining different forms of work in the teaching process. Each student responds differently to certain teaching methods, which means that while some students achieve better results with one approach, others may benefit more from another. The effectiveness of the chosen teaching method depends on many factors, including the composition of the class - not only in terms of the average grade in physics, but also in terms of the class atmosphere. The teacher should carefully select the method of instruction according to the type of lesson, with frontal instruction being more suitable for introducing new material, though it is not always the best approach for review or reinforcement lessons.

In light of this, it is recommended to expand the research, particularly to analyze how frequently different teaching methods are used, with special attention to the balance between frontal and group instruction in the teaching process.

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GRUPNI I FRONTALNI OBLIK RADA U NASTAVI FIZIKE – KOMPARATIVNA STUDIJA

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Sažetak

U radu su prikazani rezultati istraživanja efikasnosti različitih oblika nastave fizike, s posebnim fokusom na poređenje frontalnog i grupnog rada. Istraživanje je sprovedeno među učenicima drugog razreda Gimnazije društveno-jezičkog smjera u Banjoj Luci tokom školske 2023-2024. godine, na temu detekcije i djelovanja jonizujućeg zračenja. Cilj istraživanja bio je uporediti rezultate učenika koji su nastavu pratili kroz frontalni oblik rada sa onima koji su istu nastavnu jedinicu obrađivali u grupnom radu. Rezultati pokazuju da su učenici kod kojih je primijenjen frontalni oblik rada postigli značajno bolje rezultate na provjeri znanja. Zaključuje se da je frontalni oblik rada efikasniji za postizanje očekivanih ishoda, uz preporuku kombinovanja različitih oblika rada i nastavnih metoda radi što efikasnijeg prilagođavanja nastave fizike različitim karakteristikama učenika i stepenu znanja. Dalja istraživanja su preporučena radi unapređenja nastave i postizanja boljih obrazovnih rezultata.

Ključne riječi: nastava fizike, frontalni oblik rada, grupni oblik rada, ishodi učenja

Received October 17, 2024
Accepted December 24, 2024