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Results of Interactive Teaching Applied at Physics Class

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Abstract **– Nowadays in Albania, there is growing demand for qualified teachers in the subject of Physics. For universities, this need is converted into a task to produce expert teachers in this field. To do this, university professors should select and adapt teaching methods to develop expertise in physics to meet the needs of all levels of education in this area. The article deals with factual results of the application of interactive teaching methods at various courses of the Bachelor program at the University of Korça. The necessity of group work experimentation in this university was conditioned by the performance variability of the students who are studying in it.**

The interactive teaching method was applied with the help of organizing a part of the students (referred to as the 'experimental group') in formal and non-formal groups. It was applied both during lectures and seminars. Parallel to the students' part of the interactive method, the work continued with the traditional method with another group of students of the same course (referred to as the 'traditional group').

The results achieved by this method show a total increase of 1.5% of the experimental group's performance. This by referring to their pre-university assessments. Also, there is a difference of the experimental group's performance, distinctively qualitative compared to the traditional one.

Keywords **– Experimental Group, Formal Groups, Interactive Teaching, Non-Formal Groups, Traditional Group.**

I. INTRODUCTION

Over the last decades, both in the world and in our country, 'student-centered' teaching methods have been increasingly applied in higher education (Baeten et al., 2010; Lea et al., 2003). One such method is that of interactive teaching. The principles and structures of interactive teaching were developed in the 1960s and onwards (Johnson et al., 1998b) as a response to individualistic and competitive learning environments. Since then, the principles and interactive teaching structures have been adopted for the highest levels of education (Millis, 2002; Millis, & Cottell, 1998; Millis, 2010; Johnson et al., 1998a; Johnson et al. 2007, Johnson et al., 1998b). Millis and Cottell (1998) have argued that interactive teaching stimulates students the ability of thorough learning. For this reason, the popularity of this method is increasingly developed at university level (Cavanagh, 2011, Hammond et al., 2010; Hillyard et al., 2010). Researchers in this area recommend interactive teaching as an important activity in teaching university students (Biggs, & Tang, 2011; Fink, 2003). Hattie (2009) concluded that this method is one of the most effective teaching tools compared to a large number of other factors affecting academic achievement.

The daily choice of teachers to follow one or the other method in teaching-learning activity must be based on results / experimental or empirical evidence (Hattie, 2012). Given the concrete results that the literature offers today for this form of teaching, we decided to try it in our work.

II. METHODOLOGY

It involves the implementation of known and recommended forms of group work. It includes:

- *Non-Formal Groups:*

These groups are temporary. They are organized within hours of class, including 5 students in each group. Each group is asked to discuss a question posed or to solve a problem.

- *Formal Groups:*

These groups are long-term. They are organized to complete a pre-set assignment. The deadline for solving the task was determined by the degree of its complexity and the specific requirements. The optimal time was 3 weeks.

2.1. Forming and Organizing Working Groups

The first and second year students of the Faculty of Natural and Human Sciences, who study the subject of Physics, were divided into two main subgroups:

- *Subgroup I*, to which traditional didactic method was applied. This form follows the line "the teacher explains, the student listens". (Further subgroup we will be referred to as "traditional group")
- *Subgroup II*, which was the group that was selected to apply collaborative work. (Further, we will refer to Sub-group II as "experimental group")

Subgroup II by size was divided into smaller subgroups, as follows:

- 4-6 formal groups with 5 members each.
- Informal groups of 3 members each.

Selection Criterion for Creating Formal Groups:

Non-Casual. The selected students first had to have a variable range of pre-university assessment ratings, including the minimum and maximum possible evaluations. Second, the selection took into account the quality of responses through the method of prompting feedback from students versus teacher questions at the beginning of the course.

Selection Criterion for Shaping Non-Formal Groups: Casual

2.2. Work with Formal and Informal Groups During Lectures

Formal Groups:

- The experimental group of students, in each case, was split as needed into several formal groups.
- Each of the formal groups was assigned to develop a topic with several issues from the part of the Physics they were studying.

- Teamwork requires that, during the individual work phase, the structure / scheme of organizing the material is unique. Students needed to learn how to structure the selected material and write a task. To do this, they were informed in advance with several schemes - examples related to the requirements and the format of an assignment, ranging from the topic to be addressed, basic laws, the conceptualization of relevant physical phenomena, the models used, mathematical treatment solutions, etc, to argumentation of results or open questions.
- Some of the members of the group were assigned a specific role (coordinator, controller, reporter), being placed in function of the group's main task.
- Students demonstrate ideas, skills, preparation, and different ways of working. All are recommended and need to express what they know and what they are capable of doing in Physics. For this, they were given the opportunity to share information and learning ways or ways of working in general. The ideal tool to accomplish this was the working group.
- Students were encouraged to discuss topic issues with members of other formal groups.
- The time at their disposal to complete the topic assignment was 3 weeks.
- The group meetings were organized in the halls of the faculty and the school library at the specific time and date.
- At each meeting, the teacher was present with the role of supervisor, counselor, guide, exponent and encourager.
- At the end of each meeting:
- Reporting of completed work, internally and externally, during the week.
- Goals were set for the following week.
- It was analyzed, in what aspects was worked properly, in which not, and what could be improved as a group and as an individual, in the remainder of the work.
- Work ends with introducing and arguing in front of the group, class, and broader group task, and being able to answer questions from audiences. They are encouraged during the presentation to explore ideas individually, which are not included in the assignment (Bangert, 2004)

Informal Groups:

Work with informal groups was carried out in almost every classroom. Parallel to the explanation of the topic from the teacher, from time to time, conceptual questions were added. These questions (learning by questions) help in the logical absorption of information, not just transferring it from lecturer to student. This was accomplished with the help of the test of the concept (Mazur, 1997).

2.3. Work with Formal and Informal Groups in Seminars

Informal Groups:

Solving problems cannot be independent of the concepts and principles taught. When solving problems, it is important to form the kind of knowledge of the student so that he is able to apply it in a new context. In order to achieve this goal, the lecturer himself pursues a model procedure for solving a particular problem, following the established schemes (Dede & Vila, 1989; Dede & Vila, 1991). One class is organized in small workgroups with 3-4 members each and these groups are further encouraged to give ideas (within the group) to solve the problem.

In the end, the choices of each group will be taken into account. Also, it is checked and evaluated which of the groups has the most structured solution (according to the model scheme) and is given the opportunity to each member of the group to discuss with others their problem solving mode on the blackboard.

Formal Groups:

- The organization of the work was similar to the lecture.
- Formal groups at the seminars were the same as those formed since the lecture.
- The task assigned to each group was solving a complex problem, with various aspects related to certain topics in the group, since the lecture.
- The problem solution would be given in detail, according to the schema defined in the figure 3.3, and its accurate presentation is the main task of the whole group.

Solution's criteria should be objective. So, group members should focus only in those criteria that are needed to solve the problem, since unnecessary criteria reduce the number of possible solutions (Tjosvald, D., 1986).

- The problem was 'fragmented' into small pieces (jigsaw procedure - puzzle) (Aronson, E., 1978) and each of them was assigned to members of the group.

Since the particles are related to each other, this promotes the necessity of cooperation with one another.

This method educates and builds elements of expertise into students.

- The duration of the assignment was again 3 weeks.

III. Results and Discussions

Based on the detailed assessment of each student made by the teacher, data processing was done in Excel and SPSS. The following provides all details of data analysis for all cases of use of collaborative methods in the group.

The following analyzes were made with reference to:

a) Point estimates. They express the performance throughout the semester of all students. Both those of the experimental group and those of the traditional group.
b) Final assessment of the two student groups, referring to the pre-university average (gymnasium average) to see their progress when subjected to two different teaching methods.

Experimental Analysis vs. Traditional Analysis

a) Figures 1, 2, 3 and 4 show work progress assessment during the four semesters according to which

General Physics course for the two student groups is expanded, Experimental Group versus Traditional Group.

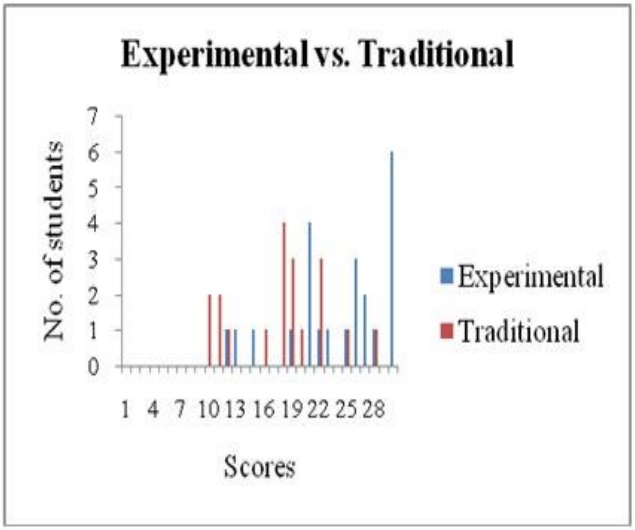

Fig. 1. Team work group assessments for students of two groups (experimental and traditional) during the first semester.

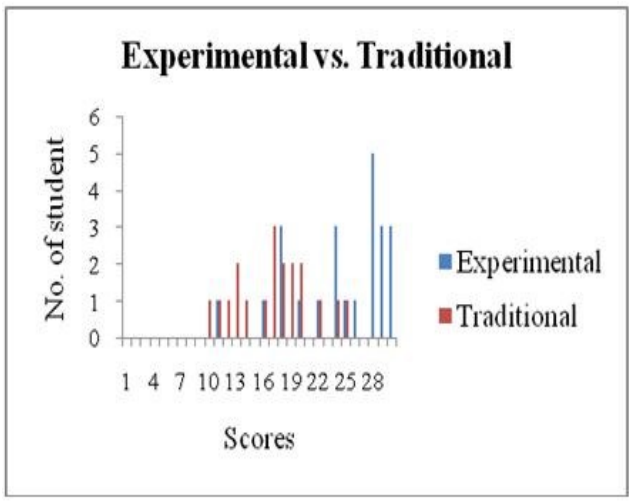

Fig. 2. Team work group assessments for students of two groups (experimental and traditional) during the second semester.

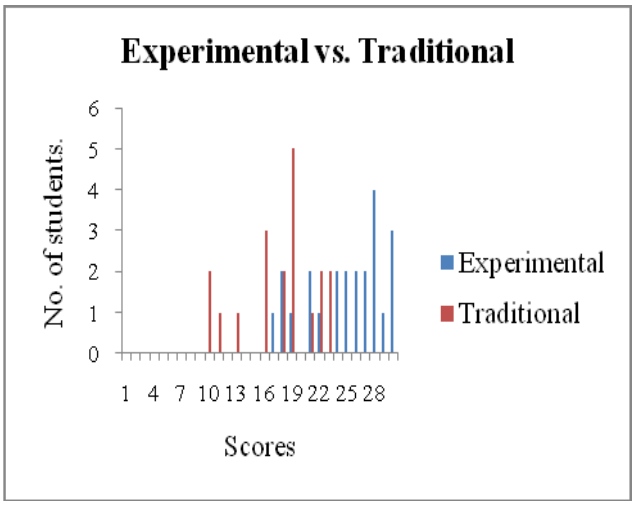

Fig. 3. Team work group assessments for students of two groups (experimental and traditional) during the third semester

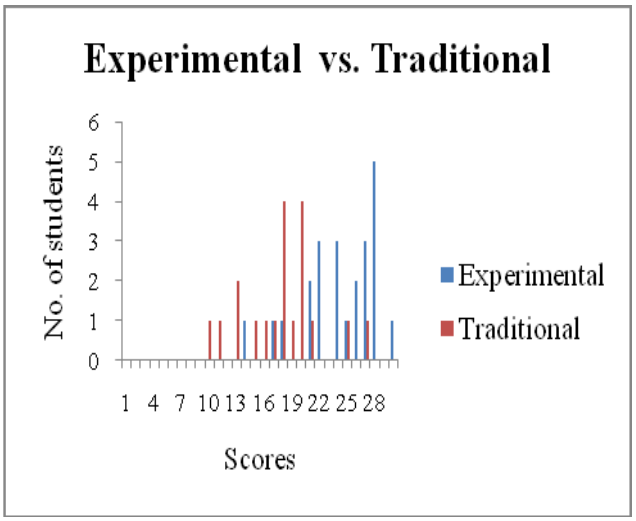

Fig. 4. Team work group assessments for students of two groups (experimental and traditional) during the fourth semester.

As expected, the assessment of experimental group students is more shifted to higher scores. Thus, during the first semester, for the experimental group, the average score per student is 24.1, while for the traditional 17.7. For the second, third and fourth semesters the points averaged for the two experimental groups versus the traditional ones are: 24.5 with 17.1, 24.8 with 17.5 and 24.2 with 17.8. On average, each student of the experimental group as a result of teamwork turns out to be about 7 points higher than his teammates in the traditional group.

b) Let's look at the statistical analysis of these two groups based on the final result of the four semesters.

Study variables are Pre-college Mean and College Mean (the university's average for Physics, extended to four semesters). The following tables summarize the descriptive statistics of these variables. As seen in the below analysis in Table 1 they are grouped according to the type of experimental / traditional group, whereas in Table 2 are grouped according to the formal groups of students within the experimental group.

From the comparison of the results of the work in the cooperative group, with the pre-college results for the same group of students in the subject of Physics, it is seen that the performance of the five groups together has increased by an average of 1.5% (Table 2, Figure 5). This is mainly due to the increase in their individual performance to 75% of the total group. Average output growth varies from group to group due to heterogeneity of the group (distribution of average student ratings), referring to pre-university assessment.

Table 1: Descriptive statistics on study variables for groups: Experimental and Traditional

Type of group		N	Minimum	Maximum	Mean	Std. Deviation
Experimental	Pre-collage Mean	23	5.30	10.00	7.7609	1.43867
	Collage Mean	23	5.00	9.75	7.8804	1.50354
	Valid N (Listwise)	23				
Traditional	Pre-collage Mean	19	5.30	9.60	7.5895	1.33204
	Collage Mean	19	4.00	9.50	6.4211	1.60739
	Valid N (Listwise)	19				

Table 2: Descriptive statistics for variables for the formal groups of the experimental group

Formal groups		N	Minimum	Maximum	Mean	Std. Deviation
A	Pre-collage Mean	5	6.50	9.50	8.0600	1.22188
	Collage Mean	5	7.25	9.75	8.3500	1.00933
	Valid N (Listwise)	5				
B	Pre-collage Mean	5	5.30	9.60	8.0600	1.75585
	Collage Mean	5	5.00	9.75	8.1000	1.88414
	Valid N (Listwise)	5				
C	Pre-collage Mean	5	5.60	10.00	7.1200	1.72395
	Collage Mean	5	5.50	9.25	7.1500	1.51658
	Valid N (Listwise)	5				
D	Pre-collage Mean	4	6.50	9.00	7.9250	1.11766
	Collage Mean	4	5.75	9.50	8.0000	1.67083
	Valid N (Listwise)	4				
E	Pre-collage Mean	4	5.30	9.30	7.6500	1.68226
	Collage Mean	4	5.25	9.50	7.8125	1.80710
	Valid N (Listwise)	4				

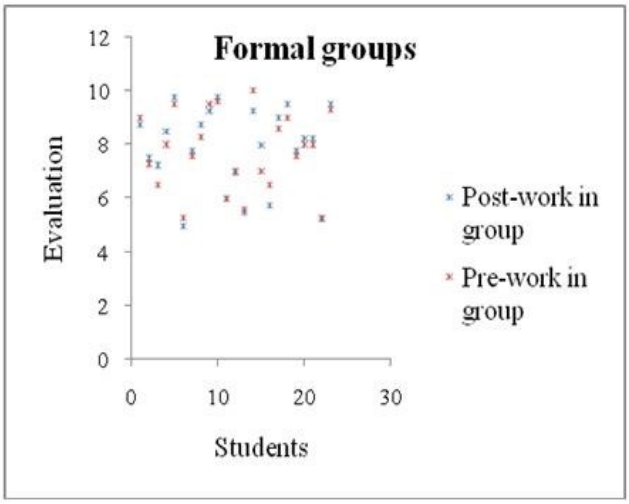

Fig. 5. Graphic illustration of the comparative results between the cooperative groups before and after the group work referring to the students of formal groups (Experimental)

Using the Shapiro-Wilk test it was confirmed that the data are of normal distribution (Table 3, p> 0.05 for both variables).

Table 3: Normality Data Tests for the Experimental Group

	Shapiro-Wilk		
	Statistic	df	Sig.
Pre-collage Mean	.950	42	.066
Collage Mean	.945	42	.061

Through the T-Test for independent groups we see whether there is any dependence on the student's achievement and the teaching method.

Initially the homogeneity of variances is verified by the Levene Test (Table 4, p = 0.61> 0.05). Then, with the T-T test, it was found that there is a statistically-significant difference between the averages of experimental and traditional groups. (t = 3.035, p = 0.004 <0.05). Based on

Table 4: Levene test for variance homogeneity and T-testfor equality of mean (Experimental)

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Collage Mean	Equal variances assumed	.270	.606	3.035	40	.004	1.45938	.48088	.48750	2.43127
	Equal variances not assumed			3.015	37.427	.005	1.45938	.48402	.47905	2.43972

Table 5. Results of Paired-T-Test for Experimental vs. traditional

Type of group			Paired Differences					t	df	Sig. (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
						Lower	Upper			
Eksperimental	Pair1	Pre-collage Mean - Collage Mean	-.11957	.41471	.08647	-.29890	.05977	-1.383	22	.181
Tradicional	Pair 1	Pre-collage Mean - Collage Mean	1.16842	.54904	.12596	.90379	1.43305	9.276	18	.000

this results and in descriptive statistics shown in Table 1 is evident that the College Mean of the experimental group is higher than that of the traditional group.

To highlight the difference that may exist, Paired-Samples T-Test was used between the average of the gymnasium and the student grade average, depending on the group they belonged to.

Table 5 shows the results of the Paired-T-Test, which shows that there is no statistically significant difference between the experimental group's average compared to that of the gymnasium (Table 5, t = -1,383, p = 0.18> 0.05). A small change exists, as we mentioned above, but it is not very statistically significant. On the other hand, it turns out that there is a statistically significant difference between averages in the traditional group (Table 5, t = 9,276, p <0.05). Table 1 of descriptive statistics shows that the average student of the traditional group has fallen from Pre-college Mean.

Graphically, the final result between the Experimental and the Traditional is given in Figure 6.

From the chart definition, in this experimental group, those who have benefited most from group work are the average and high-achievers, referring to the pre-college results.

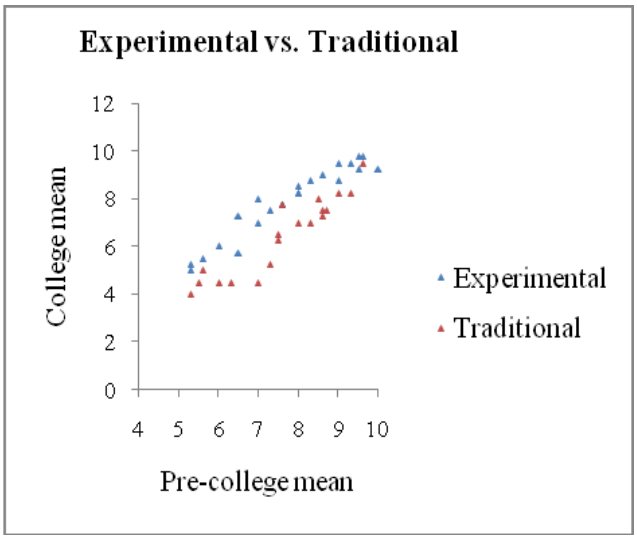

Fig. 6. Results expressed in grades achieved by two groups (experimental and traditional) for the entire Physics subject referred to the average of the pre-college mean.

As this analysis showed, for these groups, attended during the four semesters, the results of the experimental group were maintained at good levels, only thanks to the collaborative work of the group, which does not happen with the traditional group, which in every semester, has significant differences in results. The method used has yielded satisfactory results.

IV. CONCLUSIONS

1. Interactive activation, through collaborative work in groups, produced an average effectiveness enhancement of learning Physics, significantly greater than traditional methods.
2. Interactive collaboration encouraged contacts, deepened Physics debate, developed communication bridges, increased the opportunity for information in Physics, and fed the passion for this discipline.
3. Collaboration in group drew attention to various talents and different learning methods, allowed active use of teaching techniques and experimentation of deadlines for carrying out the course assignments.
4. Cooperation in group made the weak students better, and the good ones perfected in communication and explanation.
5. Each group member was responsible and interdependent on everyone else, relied on each other, and no one could have succeed alone if everyone doesn't cooperate in group.

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Lorena Kelo. Was born in 1987 in Korca, Albania. She finished her bachelor studies in Physics in 2008 and her master degree in 2010 at Faculty of Natural Science in Tirana University, Albania. She started to work as assistant professor in Korca University since 2011. The main area of her PhD studies is the methodology in teaching science in particular Physics. Mrs. Kelo has introduced and published some of her works in different conferences and journals in Europe. She and some of her colleagues are decided to find methods of teaching Physics in that way to make it the most preferred subject for the students.

Sotiraq Marko. Was born in 1961 in Korca, Albania. He has finished his studies for Physics in 1984, in Faculty of Natural Science, Tirana, Albania. In 1985 he started to work as a physics teacher. After 25 years experience in teaching in 2010 he started to work as lecturer at University of Korca. His experience is an inspiration for the new generation. As a good connoiss--eur of methodology in education, over the years he has given his contribution with many articles published in journals and newsletters in different countries. Mr. Marko is working to implement a project for training new teachers in the field of teaching methodology.

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