

THE KNOWLEDGE OF ELEMENTARY SCHOOL STUDENTS REGARDING CONCEPTS OF STATISTICS AND THEIR DIFFERENTIATION AFTER A TEACHING APPROACH THROUGH ACTIVITIES

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The purpose of this research is to investigate the knowledge of the 1st grade High School students relating to the basic concepts of Statistics that are taught in Elementary School in Greece and to determine the effect that teaching through activities has on their performance. This research, which is part of a broader research conducted by the Department of Primary Education of Aristotle University of Thessaloniki, was realised at the prefectures of Imathia and Pieria. The research provided useful conclusions, such as that the majority of teachers use traditional approaches in their teaching of Statistics, that students have a fair knowledge of most of Statistics' concepts that are included in the Elementary School Curriculum, that major improvement of this knowledge is observed after a teaching approach through activities and that the performance of students who live in urban areas is better in comparison to the performance of those who live in rural areas.

INTRODUCTION

Within the framework of the course "Statistics in Education" of the special syllabus of the Department of Education of the AUTH, which is addressed to Primary Education teachers and aims to the upgrade of their degrees, controlled tasks were organised and carried out for the teaching approach of the concepts and methods of Statistics that are taught at Elementary School in Greece. These pilot teachings were realised at Elementary Schools in the prefectures of Central Macedonia, during the school years from 1997 to 2000. More than 1000 teachers participated in this program and they taught at their schools concepts of Statistics, with a 4 or 6 hour duration, with selected or semi-selected topics. These teachings were carried out to all the Elementary School grades and more than 5 thousand students participated in them.

For the evaluation of the above mentioned program, the AUTH Department of Primary Education conducted a research in April 2001 among students of the 1st grade of High School at prefectures of Imathia and Pieria. This paper concerns the evaluation of data from 347 students. The test was carried out at schools in the capitals of these prefectures but also at rural areas. It consists of 19 questions. From these, 5 concern the way of teaching and the place of residence, and 14 cover the teaching material of Statistics included in the Elementary School curriculum.

We selected 1st grade High School students because Statistics is not taught at the 1st grade, therefore their knowledge of the concepts of Statistics is that already acquired at Elementary School. The targets of this research are:

1. To check the knowledge of basic concepts of Statistics after three years of teaching at Elementary School.
2. To investigate the differentiation that students, who participated in the teaching approach of Statistics through controlled tasks, may exhibit regarding the extent of knowledge and the ability to handle simple statistical concepts compared to students who hadn't been involved in this process.
3. The differentiation of their performance in relation to their place of residence (urban-rural areas)

TEACHING STATISTICS AT SCHOOLS

In Greece the teaching of Statistics and Probabilities was included in the Secondary Education curricula with the reform that is known in the Greek and international bibliography as "New Mathematics". The concepts of Statistics are taught from the 4th grade onwards within the framework of the Mathematics syllabus.

The emphasis that has been laid on the teaching of Statistics in all the stages of education (Primary – Secondary) is totally justified by the fact that Statistics is the subject that is most

related to everyday life and the rest fields of cognition. The new curriculum for Mathematics at Elementary School describes the sort of knowledge and skills that students will acquire at this stage of education and that aim to build research, methodology, subtraction, and reasoning and documentation skills.

THE TEACHING APPROACH THROUGH ACTIVITIES.

The Department of Education of the AUTH with the course “Statistics in Education” aimed at the supplementary training of the teachers on basic concepts of Statistics and their sensitization towards modern methods of teaching, where the objective is not to teach students Mathematics but rather to teach them how to learn Mathematics.

STATISTICAL ANALYSIS

The methods of statistical analysis that were used for the testing of hypotheses are the following: frequency distributions, contingency tables and X^2 test.

Table 1

Student percentage per area and group

Area	Students	Percentage
Urban area	246	70.90%
Rural area	101	29.10%
Group		
Group 0	272	78.40%
Group 1	75	21.60%

As far as the place of residence is concerned, the majority of the students (70.9%) live in urban areas and (29.1%) in urban – rural areas. From a total of 347 students, a 78.4% was taught the concepts of Statistics in the traditional method group (0) and a small percentage 21.6% through activities, group (1) (see Table 1).

Table 2

Student percentage per area and group

	Students	Percentage in the group
In one grade	56	74.7%
In more	19	25.3%
Total	75	100%

Out of the 75 students in group 1, the majority 74.7% was taught in this method only in one grade and only 19 (25.3%) in more than one. More specifically, 9 students were taught only in the 4th grade, 17 only in the 5th grade and 30 in the 6th grade. From those, 4 were taught in the 4th and the 6th grade at the same time, 9 students in the 5th and the 6th grade at the same time and 6 students in the 4th and 5th. From the 14 questions of the test, each of which constitutes a variable, the following results were observed (see Table 2).

Table 3

Percentage Of Correct Answers On Variables

Variable	Correct Answers	Variable	Correct Answers
V1	93%	V8	88%
V2	89%	V9	72%
V3	92%	V10	89%
V4	60%	V11	89%
V5	55%	V12	71%
V6	59%	V13	51%
V7	73%	V14	51%

As can be seen from the Table3, the students answered satisfactorily to the 3 questions relating to the interpretation of graphs (v1, v2, v3), as well as to the variables v10, v11 that were related to the prevalent value. Also, quite good is the percentage in variables v7 (interpretation of pie chart), v8 and v12 (table production), v9 (graph production). Their performance on the variables v4 (value grouping), v5 (average), v6 (variable distinction), v13, v14 (percentages) was moderate.

ANALYSIS FOR THE TRACING OF DIFFERENCES IN THE PERFORMANCE OF THE TWO GROUPS

The examination of the performance of the two groups on the 14 questions that constitute the variables is a basic research hypothesis.

Table 4
Percentage of Correct Answers In Relation To The Group, X² Test

Variables	Correct Answers			χ^2 Test	Correct Answers		
	Group 1	Group 0			Group1	Group 0	
V1	100.0%	91.0%	$p=0.04^*$	V8	92%	87.9%	$p=0.41$
V2	97.5%	86.8%	$p=0.06^*$	V9	84%	68.8%	$p=0.09^*$
V3	97.3%	90.8%	$p=0.85$	V10	96%	87.1%	$p=0.35$
V4	70.7%	56.6%	$p=0.33$	V11	96%	87.9%	$p=0.52$
V5	70.7%	50.6%	$p=0.02^*$	V12	76%	69.5%	$p=0.316$
V6	70.6%	56.3%	$p=0.25$	V13	64%	48.5%	$p=0.19$
V7	86.0%	68.8%	$p=0.01^*$	V14	64%	47.1%	$p=0.13$

As Table 4 suggests, on all the variables, group 1 preformed better. From the X² test we observe that there is a statistically significant difference between the two variables that concern the interpretation of graphs, the variables that correspond to the average, the interpretation of pie-charts and the conversion into graphs.

DIFFERENCES IN PERFORMANCE IN RELATION TO GROUP AND AREA

Table 5
Percentage Of Correct Answers In Relation To Group And Area

Variables	Urban Area			Rural Area		
	Group 0	Group 1	Total	Group 0	Group 1	Total
V1	92.3%	100.0%	*93.9%	88.5%	100.0%	91.1%
V2	87.1%	100.0%	*89.8%	85.9%	91.3%	87.1%
V3	94.3%	100.0%	95.5%	82.1%	91.3%	84.2%
V4	61.9%	75.0%	64.6%	43.6%	60.9%	47.5%
V5	49.0%	67.3%	*52.8%	52.6%	78.3%	*58.4%
V6	59.3%	71.2%	61.8%	48.7%	69.6%	53.5%
V7	69.6%	92.3%	*74.4%	66.7%	78.3%	69.3%
V8	90.7%	90.4%	90.7%	80.8%	95.7%	84.2%
V9	72.7%	84.6%	75.2%	59.0%	82.6%	*64.4%
V10	89.7%	96.2%	91.1%	80.8%	95.7%	84.2%
V11	90.2%	96.2%	91.5%	82.1%	95.7%	85.1%
V12	72.2%	71.2%	72.0%	62.8%	87.0%	*68.3%
V13	54.6%	65.4%	56.9%	33.3%	60.9%	*39.6%
V14	53.1%	65.4%	55.7%	32.1%	60.9%	*38.6%

In Table 5, we observe that students from urban areas perform better than those from rural areas on the whole of variables. The group 1 students' performance also improves in relation to the area. The exception is the average on which students from rural areas in both groups seem to perform better. Then we perform the Fisher's exact test for the existence of statistically

significant difference in relation to the area of the two teaching groups. A statistically considerable difference is observed at cases indicated in the table with *.

DIFFERENCES IN GROUP 1 IN RELATION TO THE GRADE OF TEACHING

Table 6
Percentage of Correct Answers in Group 1

Variables	Teaching in one grade	Teaching in more grades	Total
V1	100.0%	100.0%	100.0%
V2	96.4%	100.0%	97.3%
V3	96.4%	100.0%	97.3%
V4	66.1%	84.2%	70.7%
V5	67.9%	78.9%	70.7%
V6	75.0%	57.9%	70.7%
V7	85.7%	94.7%	88.0%
V8	89.3%	100.0%	92.0%
V9 *	78.6%	100.0%	84.0%
V10	94.6%	100.0%	96.0%
V11	94.6%	100.0%	96.0%
V12	73.2%	84.2%	76.0%
V13*	57.1%	84.2%	64.0%
V14*	57.1%	84.2%	64.0%

From the table we can deduce that the repetition of teaching through activities improves the students' performance in all the variables of the research. A statistically significant difference arises in the transfer into graphs and in percentages.

CONCLUSIONS

The knowledge of 1st grade High School students of the majority of the Statistics' concepts determined by the Elementary School curriculum is fairly satisfactory. As was discovered by this research, a high number of students is capable of interpreting and presenting reassert data, of interpreting graphs and constructing tables of data, of converting oral or written data descriptions into graphic ones and the reverse. We could say that they fall short in the finding of the average, the distinction of the variable, the grouping of data and the conversion to percentages.

With our teaching intervention, which was designed and executed according to the latest views on the teaching of Mathematics-Statistics, the results of the group 1 students are considerably improved. It is very probable then, that the teaching through activities method is the most appropriate in terms of students' performance in the concepts of Statistics. The investigation of the performance in relation to the area of residence showed that students who live in urban areas perform better than those living in urban rural.