"Quaderni di Ricerca in Didattica", n14, 2004.
G.R.I.M. (Department of Mathematics, University of Palermo, Italy)

TEACHER'S OPINIONS ABOUT STATISTICS AND PROBABILITY IN PRIMARY LEVEL

Sofia Anastasiadou. *Lecturer, Department of Preschool Education at Florina,*

Aristotle University of Thessaloniki

sofan@uom.gr

Abstract
At the era teaching the attitudes towards a cognitive subject is of a great scientific interest. This research is aiming to record and examine the opinions and the perceptions of Greek teachers towards the importance and the liking of teaching statistics in the primary level. The outcomes of the Implicative Statistical Analysis showed that both negative and positive attitudes toward statistics.

Resume
Dans le domaine de l'apprentissage l'attitude envers un sujet cognitif suscite grand intérêt scientifique. Cette recherche vise à repérer et examiner les opinions et les perceptions de professeurs grecs au sujet de l'importance et du plaisir de statistiques d'apprentissage au niveau débutant. Les résultats de l'Analyse Statistique Implication démontrent des attitudes positives et négatives a la fois en vers les statistiques.

Riassunto
Nel dominio riguardante l'apprendimento l'attitudine verso un soggetto cognitivo suscita grande interesse scientifico. Questa ricerca cerca di reperire ed esaminare le opinioni e le percezioni dei professori greci riguardo l'importanza ed il piacere dell'apprendimento della statistica al livello iniziale. I risultati dell'analisi dell'implicazione statistica dimostrano delle attitudini positive e negative assieme verso la statistica.

1. INTRODUCTION

In the framework of the Academic Program and the Professional Upgrade of Educators in the Primary Education which started the academic year 2002-2003 from Department of Elementary Education – Aristotle University of Thessaloniki in the region of Central Macedonia the subject on "Special Issues on teaching Mathematics" was taught.

One part of the course was "Statistics in Education". With this topic, teachers were taught three thematic parts concerning: 1. Concepts of descriptive Statistics and Probabilities, 2. Conceptual difficulties and erroneous opinions on Probabilities and Statistics and 3. Usage of Projects on teaching Statistics.

Having completed the course it was considered convenient to resolve the opinions, attitudes and behaviors of these teachers concerning the cognizance of statistics as they are asked to teach statistics and is one of the subjects of educational procedure and has decisive contribution to its outcome.

We consider that the records and study of these teachers' attitudes may be the implement, which will contribute to the assessment of the role of statistics in the first degree of education.

2. THE REASONS FOR TEACHING STATISTICS IN PRIMARY SCHOOL

It is common knowledge that information is accrued to us from many sources. The abundance of information should be easier to be collected, organized, classified, described, interpreted and used by the citizens. As we all understand, these actions can be consummated with citizens pensive, equipped with needed qualifications in order for them to find, check and handle properly and quickly the great number of information which they daily face.

In order for them to accomplish this goal they must already be equipped, in their first school years, with appropriate experiences and qualifications. With the help of the teaching of probabilities and statistics, we estimate that they will gain those sufficient "tools" as to cope with the new circumstances.

The necessity of the teaching of possibilities and statistics in the first degree of education is being pointed out by many researchers (Mendoza and Swift 1981, Adamopoulos 1994, Chadjiipantelis and Gastaris 1995, Chadjiipantelis and Primerakis 1997).

According to Mendoza and Swift (1981) the teaching of probabilities and statistics in schools is taking place for the following reasons:

1. Utility (The right knowledge of statistics helps in the elaboration, introduction and evaluation of information and reaching the right decisions),
2. Future Studies (The knowledge of the probabilities and statistics not only cultivates the mathematic thought, develops the calculating and outlining abilities but is indispensable tool to almost all scientific branches),
3. Aesthetics (The aesthetic factor contributes the student to estimate the probabilities and statistics as much in the theoretical level as in using them in sciences, in technology and in different social phenomena and with various ways and means of teaching, to discover the beauty of mathematics' science).

3. THE ANALYTICAL PROGRAM IN THE FIRST DEGREE OF EDUCATION

The contents of Mathematics must be such as to respond to the needs of all cognitive subjects of the school program.

Chadjiipantelis' and Primerakis' (1997) view is, although the equation of Statistics and Mathematics is wrong, still the Statistics as part of the subject of Mathematics in schools, is or may be an excellent tool with which Mathematics can be used and in other cognitive subjects, such as Physics, Geography, History, Economy, Social Science.

The instructions which are circulized to teachers every year report (table 1):

Table 1:Instructions

In 5th Grade: EDUCATION LEVEL	Students should be able: To fill in simple statistic tables. To present statistical data with simple diagrams, to read simple statistic tables and diagrams and to be led to the appropriate conclusions.
In 5th Grade: TARGETS	For students to become able: To collect and register systematically statistical data from their surroundings to present statistical data using statistical tables and graphic representations.
In 6th Grade: EDUCATION LEVEL	Students should be able: To collect and register statistical data from their surrounding, to present statistical data using statistical table and graphic representations, to comprehend the meaning of the average term, to estimate the arithmetical rate and to solve relative problems.
In 6th Grade: TARGETS	For students to become more able: to collect and classify statistical data, to understand the meaning of the distribution of frequencies, to find the frequency and to ascribe it in fraction and percentage, to present the distribution of frequencies in graphic representation, to understand the meaning of average term and solve relative problems, to ascribe the average term of statistics using graphic representation, to comprehend the meaning of one statistical result and on the basis of this to make relative predictions for possible results, to enforce the statistic method in simple problematic situations.

4. TATSP SCALE (TEACHERS' ATTITUDE TOWARD STATISTICS AND PROBABILITY)

The basis of Teachers' Attitude Towards Statistics and Probability (TATSP) scale is Fisbein's theory of reasoned action (Fisbein and Ajzen, 1975). In other words, the relationship between a teacher's beliefs about teaching statistics, attitudes about teaching statistics, and behaviors involving teaching statistics, would de consistent with Fisbein's model. The scale was developed presumed to measure beliefs concerning teaching statistical topics along two constructs (24 items): the importance (11 items) and liking of teaching statistics (13 items) (appendix 1). It was showed that the TATSP scale is valid and reliable when used for measuring teachers' attitudes towards teaching statistics (Anastasiadou 2002). Each question – then is graded in a Likert scale of six standards. The sequence of answers to the twenty – four questions is of graded type and takes the following form (table 2):

Table 2: Structure of TATSP scale

	Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree
Item	1	2	3	4	5	6

4.PARTICIPANTS

The data coming from search of Attitudes Towards Statistics and Probability (TATSP) were collected in Greece, in Thessaloniki in 2002-03. The sample consisted of 213 teachers from 92 public primary schools in Thessaloniki, Xalkidiki, Hmathia and Pella. The teachers who responded to the TATSP scale had a wide range of

teaching experience and knowledge of mathematics but not of statistics. The average of teaching experience was 9,54 years with a range from 5 to 20 years.

Twenty minutes of an hour were asked from the teachers in class during the last week of the academic year, in order to fill the questionnaires. The teachers filled in the questionnaires, after they were informed about the purpose of the search and the confidentiality of their answers, and after they were given instructions about the questionnaire of the search of attitudes. The participation was voluntary. It was highly stressed that it would give information concerning the subject and the tuition, in order to be used by the teachers, so that they would improve the teaching methods. It was emphasized that the questionnaire should be filled quickly, with instinctive answers.

5.METHODOLOGY

The Gras (1996) Implicative Statistical Analysis, which is based on the statistical interpretation of the concept of implication, was applied to the data. According to the Gras representation, A→B denotes that 'when a teacher gives the answer A, then it is 99% (bold arrows) probable that he/she will also give the answer B'. With the use of the software 'CHIC', which stands for the Cohesive Hierarchical Implications Classification, the consequence statistical analysis yields the implication diagram

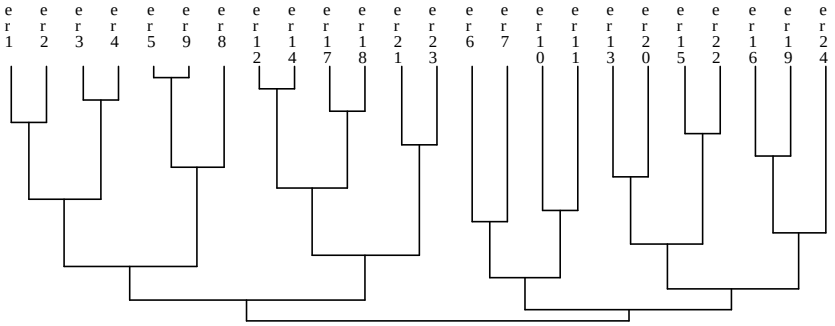
6. THE ANALYSIS OF THE RESULTS

6.1. Similarity Diagram

In the Similarity Tree factionalisms of variable on the basis of the conduct of the teachers of the research are being presented. The similarities with bold black color are significant on a scale of significance 99%. Tree four groups of similarities are being formed.

The left branch of the similarity diagram (figure 1) expresses negative attitude of the subjects of this research concerning the teaching of the subject from the teachers' point of view and the learning of the statistics meanings from the students' point of view.

The first group can be appointed as: negation group concerning the statistics. More specifically it consists of three subgroups. The first subgroup stresses the lack of necessity for the knowledge of statistics for the students (1, 2). The second subgroup (3, 4) differs from the previous one in the non-necessity in relation with the probabilities and statistics and is referring to society and the individual. The subgroup {(5, 9), 8} is referring to the non-necessity of the definition of the average term, the non-necessity of teaching statistics in school and its usefulness to students.



Arbre de similarite : C:\WINDOWS\Âðéòüíåéá åñãáóßáò\GAGATIS-SOFIA\óòíáðáâùãéêÞ-äÜóêáëïé.csv

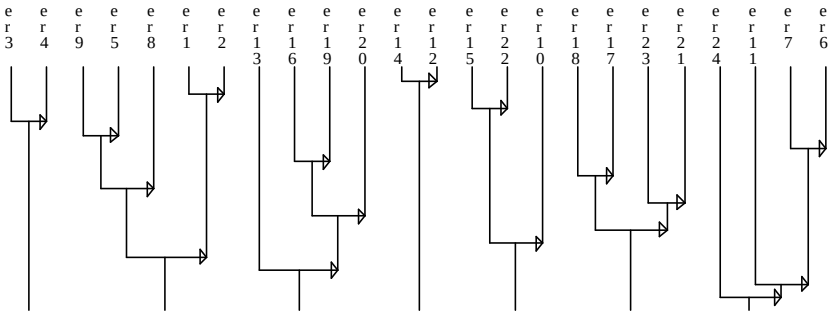
Figure 1: Similarity Diagram

The second group: The next one is also a negation group. The first subgroup (12, 14) is referring to the statistic topics (12) and the construction of tables and graphics (14).

The next subgroup (17, 18) refers to teaching disliking of probabilities and frequency. The third subgroup (21, 23) is the calculation of frequency for the students (21) and the teaching of the statistics applications (23). We observe that this group expresses specific negations.
The right branch of the similarity diagram expresses a positive attitude of subjects of this research. The first group is the positive confrontation concerning the teaching of statistics. The first subgroup which is (6, 7) expresses the importance and utility of the meanings of probabilities. And these two probably connected there on with the (10, 11) which is referring to the importance of the statistics tables and graphics (10) and the utility of the meaning of variation (11).
The following group consists of three subgroups (13, 20) and (15, 22) and {(16, 19), 24}. The (13, 20) is referring to the motives of learning of statistics. The (15, 22) is referring to the satisfaction of the teaching statistical concepts, tables and graphics and the {(16, 19), 24} refers to the students' pleasure and interest in the collection and the data analysis, the construction of tables and graphics since this is how real applications of mathematics in life are made known.

6.2. Hierarchical Tree

The Hierarchical Tree presents the implications between the variants in order of importance. The implications with bold black color are significant on a scale of significance 99%.
According to the Hierarchical Tree (figure 2) seven groups of implicative relations arise.
By analyzing the Hierarchical Tree, an implicative relation appears between the variants (3) and (4). The variant (3) concerns the lack of necessity of defining the meaning of probability on that every young person should have in order to embody oneself in society, in which this negation leads to a more general negation that the knowledge of statistic meanings is not needed for everybody.



Arbre hierarchique : A:\óõíåðáâàùãéêÞ-äÜóêáëïé2.csv

Figure 2: Hierarchical Tree

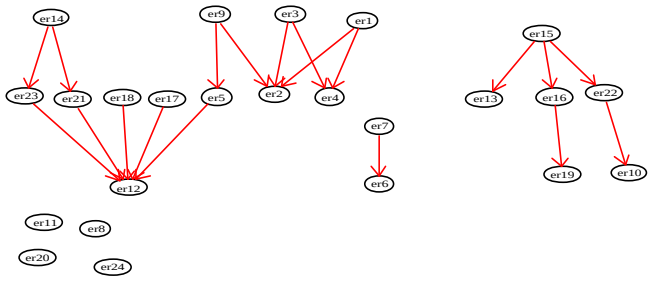
From the second group of implicative relations (9, 5, 8, 1, 2) verifications are concluded that for the teachers the ability for someone to read graphics in not so important to the students' future life (9), this leads them to a refusal concerning the necessity of the teaching of various methods of calculations the average term of a set of data (5), and these two opinions have as a natural consequence to consider that the chapters of statistics shouldn't be taught in school (8).
These opinions lead to an implication that the knowledge of statistics is not important for students to embody themselves in the society (1) since collaterally the knowledge of statistical concepts is not an assumption of success in their future school life (University) (2). The last one arouses a rather fixed and stereotyped conception in the

Greek society that the successful embodiment of young members into the society is in direct cohesion with their success or not in the University.
The third group of implicative relations (13, 16, 19, 20) concerns the teachers' views, who have a positive attitude towards the statistics. Specifically, it is made up of statements which consider that students easily find motives to learn statistics (13) and this has as result to be taken for as an interesting assignment for students the collection and data analysis (16) as the constructions of tables and graphics (19) and the two last should provide with strong motives for students to collect data (20).
The fourth group of implicative relations even if it is (14, 12) small is in opposition with the previous one since it is composed by statements which consider that the constructions of tables and graphics is not interesting to students (14) and this opinion leads to the view that statistic units are boring to students (12).
Change of group (fifth) and change of mood. Let's shift to teachers' interest towards the statistics. This group (15, 22, 10) considers that statistical concepts are one the most interesting and favorite issues to teach (15), this leads the teacher to be satisfied when teaching tables and graphics to students, since the regard that it is very important for students to use statistic tables and graphics (10).
The sixth group follows (18, 17, 23, 21) which is made up of negative statements on some issues of statistics. Specifically, this group states that it does not teach the meaning of central tendency of a set of data with pleasure (18) and this results to the opinion that the calculation of possibilities is not a pleasant issue for the students (17) and even the teaching of statistical applications and calculation of frequency does not interest the students (23, 21).
While ending this description of implicative relations from the last group of the Hierarchical Tree, relations we have an optimistic message. This group (24, 11, 7, 6) considers these statistic meaning interest students because they show the real applications of mathematics in life (24) and this general positive attitude leads them to believe that students need to understand the meaning of variation (11) and to be taught the meanings of probabilities because they are useful to a great number of professions and provides with important skillfulness which students must conquer (6). We notice that this group considers mathematics and statistics as equipments, which every new member of this society must have in order for him/her to be ready for life, without it being the only necessary way to succeed in the University. Virtually, it disconnects gaining knowledge from the school success (Entering University).

6.3. Implication Diagram

The implication graph is constituted by three implicative chains (figure 3). The first one, which is the largest and expresses a negative attitude and consists of the variants (14→23, 14→21, 9→5, 3,1→4, 9,3,1→2, 23,21,18,17,5→12). In this chain we observe that teachers consider that the construction of tables and graphics are not interesting to students (14) and this leads them to think that the calculation of frequency (21) and the teaching of statistical applications (23) it also does not arise interest to students. Furthermore the ability for someone to read graphics is not important (9) so knowledge of various methods of calculation the average of a set of data in not considered to be necessary (5). Another negation is the one which supports that people don't need to have the ability of defining the concept of probability (3) or have knowledge of the statistics (1) and leads to the fact that the knowledge of statistical concepts is not necessary to everybody (4). The disdain of reading graphics, defining the meaning of probability (3), the knowledge of statistics (1) justifies that statistical concepts are not assumption of success in entering the university (2). Finally, in this

chain we have another convergence which supports that the indifference for teaching statistical applications (23) the calculation of frequency (21), and probabilities (17) the various methods of calculating the average of a set of data (5), the disliking from the teachers' part for teaching the meaning of frequency (18), is due to the fact that students find the statistical topics boring (12).



Graphe implicatif : C:\WINDOWS\ÅðéöÜíâéá åñãáóßáò\GAGATIS-SOFIA\óõíáðáùãéóìïß.csv

Figure 3:Implication graph

The positive chain starts with the fundamental position that statistical concepts are the most interesting issues in teaching (15) and this position is disjoined to the opinion that students find easily motives to learn statistics (13) but also in the assurance that the collection and data analysis is an interesting assignment for the students (16) as the construction of tables and graphics (22) is expressed, since he considers it to be important for the students to use.

Finally, there is an intrarelational implication which concerns the utility of the probabilities in a great number of professions (7) and this is why students must conquer it as a skill.

CONCLUSIONS

Based on the results of the research two main groups of teachers have come up. The first one consists of teachers dealing with the subject negatively and the second one positively.

The first group which appears as negative group towards statistics supports the lack of necessity for the knowledge of statistics, as much in general subjects as in particular such as average term of a set of data, the frequency, the construction of charts and graphics, the teaching of probabilities.

The group, which inclines positively towards statistics, stresses the importance and utility of the teaching of probabilities, charts and graphics, the meaning of dispersion. In contrast with the previous group this group shows satisfaction as far as the teaching of statistics is concerned and recognizes motives for learning from the students' point of view since these applications show the utility of mathematics in life.

Naturally, the opinion attitudes and behaviors of the schoolteachers are in cohesion to the experiences, which were derived from during the previous studies, the knowledge sufficiency which they gained for teaching this knowledge of cognitive subjects, the view of the environment for these and their personal emotional relationship with various knowledge of cognitive subjects.

In the teachers' case it shouldn't slip our mind the fact that they are asked to teach a great number of different subjects and they should be in the position to respond to their expectations and their targets. Also the structure itself of the books which places the statistics units in the end of the books in the 5^{th} and the 6^{th} Grade in Primary

School, in combination with the extent of elements and the pressure, in the teaching year these are special restraining factors for the incorporation of statistics in education and the acceptance from the teachers' point of view.
Certainly the teachers' extra education would be a positive step towards this direction. But apart from this we think, as Chadjiipantelis and Primerakis (1997) that statistics in the Primary Education can and must move away from the tight limits of mathematics and be incorporated through various actions to other cognitive subjects. In this way, it will assist for the success in other subjects, while at the same time it will prove its utility in everyday's life, where the hiring, the control, the administration and the speed of using the information are particularly important factors. These actions (ex. Projects) will supply interscientific – inter – must probably they will find ground to be used through alternative programs like ambient education, health treatment etc and especially new coming program of a flexible zone that the Educational Institute compels with special zeal.

REFERENCES

Adamopoulos A., 'The teaching of Statistics and Probability in the secondary education', Journal: Diastase, vol 2-3, pp. 47-71, 1994.

Anastasiadou S., An instrument of identification of secondary mathematics teachers' attitudes towards statistics. Proceedings of the fifth Cyprus Conference on mathematics Education, Pafos 2002.

Chadjiipantelis T., Gastaris P, Conceptual difficulties and misconceptions in probabilities and statistics', Euklidis C, Vol 12, pp. 43, 1995.

Chadjiipantelis T., Primerakis G., Statistics in education, Curriculum and Didactics approaches, Proceedings of the 10th Hellenic Conferences of Statistics,1997.

Fishbein M., Ajzen I., Belief, attitude, intention and behavior. An introduction to theory and research. Reading, MA:Addition-Wesley, 1975.

Gras R. Implicative Statistical Analysis. In A. Gagatsis and L. Rogers (Eds), Didactics and History of Mathematics (119-121). Thessaloniki: editors.

Mentoza L. R & Swift J. Why teach statistics and probability-a rationale. In A. P. Shute (Ed). Theaching statistics and probability, 1-7, Reston, VA: NCTM, 1981.

Winstead M. S., The development of an instrument to measure two constructs of Mathematics teachers' attitudes toward teaching statistical concepts. Umi dissertation services, Ann Arbor. 1996.

APPENDIX 1 : TATSP Scale

1.Students don't need to understand statistical concepts to function in society
2.Knowledge of statistical concepts is not needed for success in school
3.Individuals do not need the ability to determine probabilities to function efficiently in society
4.Knowledge of statistical concepts is not needed by everyone
3.Students don't need to be taught the different methods of computing an average of a set of data
6.Calculating simple probabilities is an important skill for students to learn
7.Probability concepts should be taught because they are needed for many jobs
8.I do not feel that statistical topics should be covered in the normal school sequence
9.The ability to read graphs is not important to students later in life
10.It is important for students to be able to communicate using tables and graphs
11.Students need to understand the meaning of the variation of a set of data
12.Statistical topics are boring to students
13.Students are easily motivated to learn statistical concepts
14.Constructing tables and graphs is uninteresting to students
15.Statistical concepts are some of my least favorite topics to teach
16.Collecting and analyzing data is an interesting project for students
17.Calculating simple probabilities is an unenjoyable topic for students
18.I dislike teaching the concept of central tendency of a set of data
19.Constructing tables and graphs is enjoyable to students
20.Students are easily motivated to collect data
21.The different measure of central tendency are uninteresting topics to students
22.I enjoy teaching students how to develop tables and graphs
23.Discussing real-life statistics applications is uninteresting to students
24.Statistical topics are encouraging to students because they show real life applications of mathematics