

THE ROLE OF THE IASE IN DEVELOPING STATISTICAL EDUCATION

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ABSTRACT

The promotion of education in any scientific field implies paying more attention to one aspect in particular: the contact of the specialists in that science with the wider society. In this perspective statistical education (interpreted in the broadest sense possible) favours and promotes the understanding of the basic concepts of statistics in society at large, as well as in other discipline areas and /or in other professional bodies and contributes to giving statistics more visibility. In order to further the improvement of statistical education at all levels and in all contexts, the International Statistical Institute (ISI) favoured the establishment in 1949 of the Committee on Statistical Education, which ceased to exist in 1991 when the International Association for Statistical Education (IASE) was founded. Currently not all statisticians are aware of the full potential of their discipline and one of the roles of the IASE is to promote statistical education so that all statisticians may become familiar with the full potential of statistics. In this paper we describe the work carried out by this association, and its role in promoting research in statistical education. Through this research, statistics has proved to be a "modern discipline" useful for developing most of the skills required by the global world and the information society.

KEY WORDS: Teaching/learning statistics; Research in statistics education

1. INTRODUCTION

Nowadays the presence of statistics is widespread in the different University specialities, and is being introduced in primary and secondary schools in an increasing number of countries. The reasons for teaching statistics at different levels have been repeatedly highlighted over the last 20 years (e.g. Holmes, 1980; Hawkins et al., 1991; Vere-Jones, 1995; Moore, 1997). They include the usefulness of statistics for daily life, its instrumental role in other disciplines, the need for a basic statistical knowledge in many professions and its role in developing a critical reasoning.

The world in which we live is rapidly becoming like a "global village", as it is closely connected by modern telecommunications and interdependent economically, socially and politically. In this new world it is important to be able to orient oneself in a web of available information, much of which is quantitative. As a result the modern citizen requires new skills related to data collection, organisation, analysis and interpretation.

The citizen must know the conventions, which permit him or her to judge the quality of quantitative information divulged by the media. He or she must be able to use the quantitative data to control the expression of his or her own, and others', opinions and must be aware of how quantitative information

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can be of use in problem solving and in choosing from a variety of possible solutions. Statistics is capable of supplying these cultural and practical needs. Particularly, statistics attempts to explain the variability inherent in all phenomena, which is the diachronic and synchronic tendency to change, which is present in the real world. Therefore the study of Statistics is necessary for the citizen to fully develop his or her capacity to orient him or her self in his or her world, and not solely as a technique, but as a way of thinking which has become the necessary means to obtain a quantitative awareness of socio-economic phenomena. Consequently, this is necessary to permit the existence of a complete democracy.

This is so highly recognised at international level, that UNESCO implements policies for development, both socio-economic and cultural, for all the Nations, which include not only literacy but also numeracy. This being the case, statisticians feel the necessity for the diffusion of Statistics, not only as a technique for dealing with quantitative data, but also as a culture, in terms of capacity to comprehend logical abstraction, which makes the quantitative study of collective phenomena possible. Statistics is concerned with complex study which, starting from a definition of the object under examination, and thus a definition of whatever one seeks to measure, passes through data collection, its representation and analysis in order to reach the extremely delicate phase of interpreting and commenting, which renders explicit the knowledge of the phenomenon which has been studied.

Facing the problem of the statistical culture and its diffusion is therefore much more than concerning oneself with training a few specialists. It means, in fact, for statisticians, to take the general knowledge possessed by the average person nowadays, in order to allow him to fulfil the needs of an information-based society, towards which we are progressing rapidly. Discussing the diffusion of the culture of statistics, requires a mid – to long term perspective. Such time is necessary for people to be trained in statistics in schools, it is necessary for people to understand that statistics is linked to a way of reasoning which allows the acquisition of knowledge through experiments and/or observations; time is necessary because people learn to value technical awareness and even more so acquired logic, so that quantitative information can be consciously used, whether collected by oneself or provided by external sources.

The aim is to train citizens who are able to evaluate statistical data critically, even from official sources, since he or she is conscious of the procedures by which the data is obtained, knowing that even the best statistical data is only the representation of a part of reality: that which has been observed. He or she is aware that the data available is merely an image of reality and not true reality itself, which mankind will not be able to take hold of, even through statistics.

The critical focus towards data must be counterbalanced by the awareness of the usefulness of the information required concerning the reality under examination, whether it be for a merely cognitive aim, or a decision –making one. In other words the statisticians have to succeed in making the usefulness of statistics evident, and above all making its way of reasoning understood.

2.THE ACTIVITY OF THE ISI TO PROMOTE STATISTICAL EDUCATION

In order to further the improvements of statistical education at all levels, and in all contexts, the International Statistical Institute (ISI) favoured the establishment of the International Association for Statistical Education (IASE) in 1991. The birth of the IASE was the end of a long move initiated in 1949, immediately following the Second World War, with the founding of the Committee on Statistical Education within the ISI, through which the Institute itself promoted the university training of statisticians at an international level, while in developing countries the ISI concerned itself with the education of official statisticians (Rice, 1949; Nixon, 1960; Goudswaard, 1964; Gani, 1979; Vere-Jones, 1995). The ISI has begun to pay more attention to teaching statistics in schools since the mid seventies. In those years, mainly in developed countries, socio-economic conditions improved, quantitative information given by governments and published in newspapers was ever more frequent, and personal computers became ever more widespread. Moreover the teaching of mathematics in schools began to change, so that statistics and probability could also find a place within the mathematics programme in pre-university

schools, and statisticians became conscious of the necessity to go deeper into the teaching/learning problems that teachers of mathematics had to face when dealing with teaching statistics in schools.

In 1976, the ISI re-emphasised its propositions for statistics teaching (Zarkovich, 1976). Knowing that the theme of teaching could offer the best possibility of influencing the future development of statistics, the ISI underlined the necessity to:

- Produce comprehensible university textbooks with applications connected to “real life”;
- Encourage the definition of high school and university programmes, above all those of new institutions;
- Publish a Journal to assist teachers at different levels in terms of keeping them informed;
- Organise general meetings, for those interested in the teaching of Statistics, different from those formal ISI Round Tables organised up to that point for experts in statistical education.

From 1979-1987, the Education Committee, chaired by Professor Gani, succeeded in obtaining important results, through the creation of diverse “Taskforces”. Thanks to these, but also thanks to the willingness and involvement of those in charge of each taskforce, significant initiatives were taken. In 1979, at the International Centre for Statistical Education at Sheffield University, “Teaching Statistics” was first published, one of the most important didactic statistical Journals distributed in secondary schools, colleges and universities all over the world. Furthermore the International Conferences on Teaching Statistics (ICOTS), the first of which was held in Sheffield in 1982 (Grey at al., 1982), were initiated and they continue once every four years. The International Statistical Education Newsletter (ISEN) began to be published in order to inform ISI members of the Committee’s work, and to keep them up – to- date as regards teaching statistics and its problems.

The publication of “Teaching Statistics” and its distribution, and the success of the ICOTS demonstrated that statistics teachers felt a strong need to unite, talk, and discuss the problems experienced in the course of their daily activities. In the meantime, it gave specialists in epistemology, psychology and statistical education the possibility to expound the results of their research and theories. At the beginning of the 1990s, it became clear that there were forces and energy for the creation of an International Association for Statistical Education. These forces became recognised in the course of the ICOTS and would have emerged even without the leadership of the ISI. Consequently, at the Cairo Conference in 1991 the proposal to establish an International Association for Statistical Education as a new Section of the ISI was approved by a unanimous vote of the ISI General Assembly. With the establishment of the IASE and the transfer of statistical education activities to it, the Education Committee ceased to function as such.

3. THE IASE AND THE ADVANCEMENT OF STATISTICAL EDUCATION

According to the Statutes for the IASE: “The objectives of the Association shall be to promote the understanding and advancement of statistical education and related subjects and to foster the development of effective and efficient educational services through international contacts, among individuals and organisations including statistical educators and educational institutions”. To fulfil these aims the IASE was expected to develop a publication programme as well as to continue with the program of ICOTS and Round Table Conferences and, in addition, at the Biennial Session of the International Statistical Institute, to organise Invited Paper Meetings on the subject of statistical education. Besides this it was envisaged that a number of committees and working groups would be formed to address specific areas of common interest.

Thanks to a Transitional Committee, in charge from 1991 to 1993 and chaired by D. Vere-Jones, the first election of IASE Officers was prepared as well as the first General Assembly that was held in Florence (Italy) on August 27, 1993. Since then the IASE has had four elected Executive Committees. The first was chaired by D. Moore, USA, (1993-95), the second by A. Hawkins, U.K., (1995-97), the third by M. G. Ottaviani, Italy, (1997-1999) and the fourth chaired by Brian Phillips, Australia will take over in August 1999. As a professional association for people with a strong interest in statistical education, the IASE

gather those researchers on teaching and learning and those who develop materials and teach at all levels from schools to specialist training. The community of teachers, educators, researchers forming the IASE memberships has allowed the Association to bring many initiatives to a successful conclusion.

Sessions on statistical education have been organised by the IASE at the general 50th, 51st and 52nd ISI Sessions held respectively in Beijing, 1995, Istanbul, 1997, and Helsinki, 1999 and others are being planned for Seoul, 2001. The IASE has continued to sponsor Roundtable Conferences on specific topics as satellites to the quadrennial ICME meetings. In 1992 the IASE Round Table was held in Lennoxville, Quebec, Canada dealing with the topic: *Introducing Data Analysis in the Schools: Who Should Teach it and How?* The proceedings, edited by L. Pereira Mendoza, provide a broad perspective of differing issues associated with statistical education with a particular emphasis on data analysis. In 1996 the IASE Round table was held in Granada, Spain, on the theme: *Research on the Role of Technology in Teaching and Learning Statistics*. The proceedings, edited by J. Garfield and G. Burrill, develop a wide range of interest and expertise on a theme provoking a widespread international debate on a topical issue facing statistical educators.

No doubt, however, the International Conferences on Teaching Statistics (ICOTS) are the most important means of interchange that the IASE offers to the community of professionals and researchers concerned with statistical education. The ICOTS meetings are notable as a venue for discussing statistical education with people of the most varied backgrounds. In 1994, ICOTS 4 was held in Marrakech, Morocco, sponsored by the ISI and the National Institute of Statistics and Applied Economics of Morocco. The proceedings included topics ranging from the statistical literacy of citizens, through the teaching of statistics to various specialised groups - such as economists, engineers, official statisticians, and social scientists -, to data analysis for the elementary curriculum. In addition, several work groups sessions were held which provided the opportunity for in-depth discussion of certain specialised topics; one in particular was devoted to the "Activities of Professional Societies in Education and Public Awareness of Statistics". ICOTS V was successfully held in Singapore, 1998 and plans are under way to hold ICOTS VI in Durban, South Africa in 2002.

Other meetings have been added to the traditional ones. In 1993 the First IASE Scientific Meeting was held in Perugia (Italy) as a satellite to ISI Florence. The papers published in the Proceedings covered – in addition to classroom and curriculum problems in schools and universities – such topics as: the training of government statisticians, the use of videos, training in consultancy, electronic communication as a tool, and statistical education in developing countries. In 1994 the Second IASE Scientific Meeting took place in Cairo, in Arabic, discussing the teaching of statistics problems at pre-university level, as well as teaching mathematical statistics and probability, teaching statistics for students of basic and experimental sciences and teaching statistics for students of humanities at the university level. The Proceedings were published in the Arabic language. IASE has presented a summary of its activities in other conferences with statistical education component, such as the Joint IAOS/IASS Conference. Aguas Calientes, México, 1998 (Ottaviani, 1998), IV Iranian Statistical Conference, Tehran, 1998 (Batanero, 1998), and IV Conference of Latin-American Statistical Societies, Mendoza, 1999 (Ottaviani, 1999).

The IASE has also a collection of books on statistical education that carry its logo. The most recent additions are: *Papers on Statistical Education presented at ICME 8* (1996) edited by B. Phillips to collect statistical education issues covered by the IASE at the 8th International Conference on Mathematical Education (ICME); the *Proceedings of Tartu Conference on Computational Statistics and Statistical education* (1996) reflecting a statistically representative sample of the problems discussed at this IASE/IASC Conference; the volume on *The Assessment Challenge in Statistics Education* (1997), edited by I. Gal and J. Garfield, a book discussing conceptual and pragmatic issues in the assessment of statistical knowledge.

4. IASE CONTRIBUTIONS TO DEVELOP RESEARCH IN STATISTICS EDUCATION

4.1 Introduction

The increasing interest towards statistical education has also led to a world-wide community involved in research on the problems of teaching and learning statistics and probability, which include not only statisticians but also mathematics educators, and psychologists. Because of the contributions and mutual exchange of these three research sources, as well as from the collaboration between specialists in these disciplines and others such as pedagogy, history and sociology, statistical education is now coming of age, as an academic speciality.

4.2. The psychological perspective: research into stochastic reasoning

Earlier research, which influenced statistical education, came from Psychology. There has been such a strong influence of research into stochastic reasoning on psychology that this probabilistic revolution has been compared with the influence of cognitive studies. This new perspective, as well as the interest in the evolutionary development of stochastic ideas from childhood to maturity, have produced numerous psychological investigations into children's and adults' stochastic reasoning (Shaughnessy, 1992).

A shift in the works on human reasoning have been produced in these studies from a model where humans were considered to reason according to formal logic, to other where man is seen as a decider, who behaves according to a complex probabilistic system, and uses heuristics acquired in his empirical relationship with daily events. These heuristics or unconscious strategies reduce the complexity of stochastic problems, by suppressing part of the relevant information. However, they cause biases in the conclusions obtained, and are observed even in people with a high level of statistical training, when working outside academic contexts. A well-known example of these biases is the "gambler's fallacy", where stochastic processes are supposed to have a memory that they do not possess. This unconscious belief is so widespread that it is rare to find people who would not bet on tails after a long run of heads when flipping a coin. Works such as those by Kahneman and cols. (1982), which involve amongst other points correlational reasoning, inference, conditional probability and Bayes' rule, have contributed to characterising these biases and to the paradigm change within psychological studies.

On the other hand, and starting out from Piaget and Inhelder (1951), the acquisition of the ideas of randomness and probability, combinatorial reasoning, the intuition of relative frequency, distribution and convergence, as well as the ability to compare probabilities have been analysed from childhood to adolescence. As a consequence, different probabilistic reasoning stages have been described. Other authors have also analysed the influence of children's' proportional and combinatorial reasoning, prior beliefs and animist conceptions on their capacity for perceiving randomness.

Particular mention should be made to works by Fischbein (1975), since they constitute a main link between psychology and education. Beyond the formation of formal concepts, he was interested in the emergence of partial intuitions about stochastic concepts, and the effect of instruction on the psychology of learning probabilistic concepts. Fischbein was one of the founders of the PME group (Psychology of Mathematics Education), which is holding its 23 annual meeting in 1999. In 1994, a discussion group on stochastics was started up inside PME that turned into a working group in 1997 with the goal of linking two research areas: studies concerned mainly with psychological aspects of stochastics learning, particularly decision-making in an uncertain environment; and studies concerned mainly with pedagogical aspects of stochastics education.

Research into children's stochastic reasoning suggest that learning probability and statistics is well described by that theory of learning which is known as "Constructivism". This theory stems from the work of Piaget and his collaborators and has been widely accepted within mathematics education. "Constructivists view students as bringing their own ideas to the classroom. Rather than receiving material in class as it is given, students restructure the new information to fit into their own cognitive

frameworks.” (Garfield, 1995, pages 25-26). In this context the teachers’ task is essentially to provide opportunities for students to actively construct knowledge, acting as a coach, a moderator or a consultant who presents the material, solicits opinions and responses from the class, rather than someone who has to transmit a designated topic.

A fundamental strategy in constructivist theory is problem-solving. Problem-solving consists of encouraging the student to solve a problem and to widen his/her knowledge through the analysis of a particular situation, the formulation of a project, by gathering information, interpreting the data, verifying the hypothesis and generalising about the results. With regard to “Constructivism” statistics no doubt enjoys a privileged position. Working with data, forming dialogues with this, and interacting with those areas of application which the data refer to, is in fact the statistician’s habit of mind.

4.3. Research from the perspective of mathematics education

Research in statistical education is also starting to appear within Mathematics Education departments and Doctoral Programmes. The interest in the teaching of statistics, within mathematics education is linked to the progressive changes that statistics is experiencing nowadays, both in its content – available statistical procedures- and in its users. All this has produced great demand for basic training in this area, which is usually the responsibility of mathematics teachers at school level. To follow we analyse the problems that teaching statistics involve for these teachers.

It is always difficult to teach a rapidly developing subject, but it is especially difficult to teach stochastics for a number of other reasons as well and difficulties appear even in very elementary concepts (Batanero et al., 1994). Firstly, the very nature of statistics is contrary to the traditional deterministic culture of most mathematics classrooms (Steinbring, 1990). An indicator of this situation is that even nowadays philosophical problems on the interpretation and application of basic concepts such as probability, randomness, independence or hypotheses testing are still matters of debate among experts.

Moreover, while concrete manipulative objects offer a support for the learning of basic operations in arithmetic or geometry, the irreversible nature of random experiment results hinders the support of this concrete material. Although simulation can be used to study random experiments, their variability makes the convergence of the experiences carried out in the classroom uncertain. Not even a repetition of the experiment can serve to check a result, as we use to do, for example, with arithmetic operations.

On the other hand, statistical problems are usually open- ended (beyond routine exercises). Since the formal teaching of statistics and probability at secondary level frequently takes place in mathematics classrooms, teachers tend to adapt their vision of stochastics and its teaching to the approaches and standards of reasoning used in other branches of mathematics.

Primary and secondary level statistics teachers frequently lack specific preparation. For example, in Spain, prospective secondary teachers with a major in Mathematics do not receive a specific training in statistics education. The situation is even worse for primary teachers; most of who have not had basic training in statistics and this could be extended to many countries. There can be little support from the textbooks and curriculum documents prepared for primary and secondary teachers, because these can frequently be misleading (Truran, & Truran 1994).

On the other hand, statistics, which by its very nature is multidisciplinary and privileges the dialogue with data, facilitates teamwork among experts from various sectors. This might be demanding in itself, and contrary to the traditional demarcation of subjects in most schools and Universities, which may cause conflicts when the definitions or properties of the concepts do not coincide with those taught in the mathematics classroom. The teacher’s choice of data for the students’ use is of particular importance in the success of this kind of teaching, and should promote group discussion and favour the introduction of important statistical concepts. The preparation of suitable material, also capable of encouraging class interaction, is much more time consuming than a good, standard in-class lesson. So, it seems necessary to

have a better prior training for teachers as well as the permanent support from University departments and research groups. The role of professional associations, such as IASE also seems to be decisive, when starting up active local groups that link statistical professionals and researchers in statistical education with statistics teachers.

Finally, research into statistics education is still very scant so that students' main difficulties in many important concepts are still not well understood. Experimenting and assessing teaching methods adapted to the specific nature of statistic, to which the general principles of teaching mathematics cannot always be transferred, are also needed.

5. IASE ACTIVITIES IN RELATION TO RESEARCH

The influence of IASE in developing research and in linking researchers from different areas has been made evident both by the activities promoted by the Association, as well as by its members. ICOTS and Round Table Conferences in particular play a very important role in promoting research, because in these conferences IASE provides adequate forums where research problems, methodologies and results are presented and discussed.

Last year, in Singapore, the Association organised the Fifth International Conference on Teaching Statistics, with the participation of about 300 delegates from all over the world. Meeting together is always a moment of great pleasure and interest for all who work in the field of Statistical education. Usually, in fact, they are a little isolated within a department of statistics or mathematics and statistics or educational sciences, so that consequently they are afraid of having their own opinions and interests, which are not commonly shared by others.

The materials presented at the fifth ICOTS from June 21st to June 26th, 1998, contributed to strengthening how important the teaching of statistics is from didactic and pedagogic viewpoints, for furthering those individuals' skills needed in a modern society. It was also shown that a cumulative body of knowledge on the evolutionary development of stochastic concepts, and on students' difficulties on specific concepts is now being created. A collective interest is also arising within IASE for basing new research on previous investigations and for the theoretical reflection on the foundations and research methods. However, more research is needed into changes in students' conceptions as a consequence of teaching experiments and synthesis of previous researches that is very scattered. One related problem is the lack of specific programs for training researchers in statistical education, although doctoral programs in mathematics education or in statistics, supplemented with some specific courses, could fulfil this function. It is also important to define which are the main research problems and methodologies in our field, as well as to define criteria to assure the validity, reliability and relevance of its results.

Another important issue became evident at ICOTS 5. Among the keynotes, two papers were presented by professional statisticians: Paul Cheung, Chief Statistician, Singapore, discussed "Developments in Official Statistics and Challenges for Statistical Education" and Roger Luk, Managing Director and Deputy Chief Executive, Hang Seng Bank, Hong Kong, PRC, talked about "Application of Statistics in the Business World". Both of them showed the need for quantitative information and its ever wider use by governments and economists. Each in a different way illustrated that "Like any science subject, the theory of statistics is meant for a perfect or ideal world, which hardly exists in reality", and so when applied to reality the consciousness of the phenomenon under examination is needed to help the user in bridging the gap between theory and practice.

In this way two key issues emerge from the concerns of the Conference:

- The demand for research in statistics education to be recognised as a research discipline in its own right in an academic world;
- The problems in statistics training of those researchers and professionals who must then apply statistics to diverse substantive disciplines.

The first problem may be solved when the community of statisticians and, in general the community involved in statistical education, will make clear the awareness that the researchers in statistical education have their own particular and important role. As statisticians, they investigate statistical education, using statistics as an instrument with which they can contribute at the same time to the development of theory and application of the discipline. As scholars of the science of education, they permit the better knowledge of logical processes of teaching/learning of statistics.

As regards the problem of the training of those researchers and professionals, who have to use statistics, one of the biggest challenges to face is to avoid the risk of "fragmentation of the subject" feared, among others, by such illustrious statisticians as Cox (see Cox, 1997, p.262). Perhaps statistics needs to be better characterised, making evident its peculiarity, which consists of the quantitative study of real phenomena. So, it might be possible to recover the entire process of scientific investigation from the design through data collection and data analysis to the interpretation of the investigated phenomenon, without limiting oneself solely to the phase of data analysis, as some statisticians are used to thinking today. Possibly an attentive, patient work of reconstructing history, logic, philosophy, and epistemology of statistics could help to attain this fundamental goal. But this could also be the way to find those "general principles of statistics" (Cox, 1997, p. 261) that apply to experiments as well as to observational studies. To single out these general common principles should favour "a teaching approach that could be relevant and accessible to both specialists and non specialists, keeping in mind that an understanding of general principles gives flexibility and transferable skills" (Hawkins, 1997, p.281).

Finding these "general principles" should also help in " Bridging the gaps among School, College, and the Workplace", as R. Scheaffer titled his brilliant keynote discussed at ICOTS 5. In giving an articulated perspective about the way to bridge the gaps among statistical education and training aspects on one hand, and the statistical needs in society and particularly in the workplace on the other, Scheaffer concludes: "The process of building a solid core of statistics into the school and college curriculum is one of infusion for the many and specialisation for the few". No doubt to plan this particular building is a fundamental challenge the statisticians have to face in the immediate future and this poses new research problems.

The IASE is fully aware of the importance of the subject and will confront, in a systematic and articulate way, the theme of training researchers at the next Round Table on the theme: "Training Researchers in the use of statistics", to be held in Japan in the year 2000. Empirical sciences rely heavily on proving the existence of effects using the statistical analysis of data. Statistical inference dates back almost 300 years, however, since the logic of statistical inference is difficult to grasp, its use and interpretation is not always adequate and has been criticised for nearly 50 years and statistical education can not forget this problem. A number of researchers from different countries, and with expertise in applying statistics to different fields will present and discuss papers related to the following topics: Statistical competencies that researchers in different disciplines should acquire in their postgraduate training; Needs and problems in the statistical training of researchers in specific fields; Main learning problems, misconceptions and errors concerning advanced statistical concepts and procedures; Design/ evaluation of courses for training researchers in particular statistical topics; Effects of technology on the statistical training of researchers; Assessing/ identifying frequent errors in the use of statistics by researchers; Researchers' attitudes towards statistics and its effect on the role of data analysis in experimental research; Consultation as a teaching/ learning process and Informal statistical learning from reading research literature.

Other initiatives directed to develop research in statistics education are being organised by IASE members. The International Study Group for Research on Learning Probability and Statistics was started in ICOTS I (1982) in order to encourage research in statistical education; promote the exchange of information between members; develop instruments by which concepts about probability and statistics could be assessed; and in general improve the teaching and interpretation of probability and statistics by dissemination of research findings There have been three secretaries of the group: D. Green (1986-88); J. Garfield (1988-96) and C. Batanero (since 1996). This year the Study Group, which have now over 200 researchers in 40 countries is organising its first Research Forum to be held in the Kibbutz Be'heri, Israel with the main aim to discuss the topic of Statistical thinking, reasoning and literacy. During ICOTS 5 a

network system was launched connecting together people who share their professional interests. Six new lists on particular themes related to statistical education were proposed at ICOTS V and four of them have already started as email lists.

Besides the IASE, other statistical or educational institutions organise or are beginning to organise specific statistical education sections, which very often have been promoted with the help by IASE members. Some examples are the American Statistical Association, The Royal Statistical Society, in England, The Japanese Statistical Society, The Italian Statistical Society, The Research Group in Statistical Education at the School of Mathematical Sciences, Isfahan University of Technology, Iran; the French Commission Inter-Irem for teaching probability and statistics, the Spanish Society of Research into Mathematical Education.

6. CONCLUSIONS

The trends presented in the paper suggest a great growth in the interest towards statistical education in a near future. When we closely analyse the content of the field, we see that it is highly complex and diversified. Its implications for teaching cover everything from primary education to University, professionals, teachers, technicians, and official statisticians. There are also many different problems to be studied: Research, curricular development, learning problems, reasoning ways, assessment, attitudes, appropriate use of statistics, relationships with other disciplines, history and philosophy of statistics and statistics education, materials and resources, including didactic software,

Statistical education is evolving at a quick pace. Textbooks are beginning to appear in electronic and freely accessible editions, which can be consulted or modified on Internet. It is also easy for students to obtain all types of data to carry out research into almost any topic, even with few resources available. Teachers can download these data sets from Internet and introduce them into the students' graphic calculators. In this way, the students can analyse the data at home or export them to other computers or calculators. They can also combine different data or send their own data sets to other students in the same or a different country. Teachers or students' discussion lists, remote tutoring, when direct communication with the teacher is difficult, are already being experimented at some schools and Universities, such as, for example, in the Australian experiment for remote teacher training (Watson, 1998). The pace of technological changes makes it likely that there will be an extension of new ways for teaching and learning in the near future (Thisted and Velleman, 1992; Ottaviani, 1997) and this poses new problem of research and development for education.

The activity and research of the IASE and its members give rise to results that are important not only to the Association itself, but also to the community of the statistician. The promotion of education in any scientific field implies paying attention to a delicate aspect: the contact of the specialists in that science with the wider society. In this perspective statistical education (interpreted in the broadest possible sense) favours and promotes the understanding of the fundamental concepts of statistics in society at large, as well as in other discipline areas and /or in other professional bodies. This obviously contributes to giving statistics more visibility. Currently not all statisticians are aware of the full potential of their discipline and one of the roles of the IASE is to promote statistical education so that all colleagues may become familiar with the full potential of statistics. This also requires the IASE to promote the diffusion of the different activities that the Association has organised and is going to organise first of all by contacts within the ISI family that is to say with the Bernoulli Society, the IAOS, the IASC, the IASS and the ISI itself.

As C. Jarque, the President of the INEGI noticed in his keynote address at this joint IASS/IAOS Conference "we all share a planet full of significant and accelerating ecological, demographic, economic and scientific transformations that reach into every corner of life." "In summary, the environmental, demographic, economic and scientific transformations constitute clear trends which require priority attention by the world community at the end of this millennium. In particular, they already have an

enormous impact on the demand of statistical data, on statistical methodology, and on national and global statistical systems.” (Jarque, 1998, p.108, p.111).

The statisticians cannot but agree with C. Jarque. They have to consider, however, that to have “good” statistical data requires “good” statisticians who can dominate the entire process of scientific investigation and can plan, design, collect and analyse data, and interpret them, but it is also necessary to have citizens conscious of the importance of data collection and surveys as well as of the utilisation and interpretation of data. There is a clear relationship between the better availability of efficient statistical information and economic development, as well as between better statistical training and a greater efficiency in the production and interpretation of statistical information.

All of this requires the promotion of Statistical Education at all levels, and this is the IASE’s objective. Active groups of statistical educators in a country contribute to improving the statistical preparation for its citizens. Statistical educators’ commitment and solidarity, and their participation in international associations, such as the IASE, is therefore, necessary so that the expansion of statistical education and the formation of co-operative links may be a reality for the majority and not just a minority privilege.

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