

# **THE PROMOTION OF STATISTICAL EDUCATION: THE ROLE OF THE IASE AND ITS COOPERATION WITH DEVELOPING COUNTRIES**

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**ABSTRACT:** 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. Through research in statistical education, statistics has proved to be a “modern discipline” useful for developing most of the skills required by the global world and the information society. Currently one of the roles of the IASE is also to spread the findings of statistical education research in order that all statisticians may become familiar with the full potential of statistics as a discipline. Within developing countries, the IASE should fulfil this fundamental aim encouraging the creation of local groups of statistical educators who, thanks to easily accessible co-operative links, are able to expand statistical education taking advantage of international collaboration and information-sharing.

**KEYWORDS:** Statistical education, Teaching/learning statistics; Research in statistics education

## **1. INTRODUCTION**

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. He or she must, for example, move within masses of quantitative data which may at times be contradictory and which require of him or her a minimum awareness of how such data is collected, organised, analysed and interpreted.

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 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. In fact it concerns itself with the quantitative study of collective phenomena, whether they be economic, demographic, social, or of an experimental nature. 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, having become the required means to obtaining a quantitative awareness of socio-economic phenomena, is consequently necessary in order to allow a complete democracy to exist. 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.

Facing the problem of statistical education and culture, and their diffusion, is therefore much more than concerning oneself with training a few specialists; it means, in fact, for statisticians, relating to the general know-how possessed by the average person at present, in order to allow him to fulfil the needs of an information-based society, towards which we are progressing rapidly. The aim is to train citizens who, on one hand, are able to evaluate statistical data critically - also that from official sources - and, on the other, are aware of their usefulness 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 its way of reasoning understood.

## **2. THE ISI AND THE PROMOTION OF 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 international level, while in developing countries the ISI concerned itself with the education of official statisticians (Rice, 1949; Gani, 1979; Vere-Jones, 1995). The ISI had begun paying more attention to teaching statistics in schools since the mid seventies. In those years, mainly in developed countries the teaching of mathematics in schools began to change, so that also statistics and probability could 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), recognising that the theme of teaching could offer the best possibility of influencing the future development of statistics. From 1979-1987, the Education Committee, chaired by Professor Gani, succeeded in obtaining important results, through the creation of diverse "Taskforces". 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, 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 existed 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 AND RELATED RESEARCH**

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 publications programme as well as to continue with the program of ICOTS and Round Table Conferences and statistical education sessions at more general meetings. 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 (1997-99), the fourth by Brian Phillips, Australia (since 1999).

As a professional association for people with a strong interest in statistical education, the IASE includes both those who conduct research 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 50<sup>th</sup>, 51<sup>st</sup> and 52<sup>nd</sup> ISI Sessions held respectively in Beijing, 1995, Istanbul, 1997, Helsinki, 1999, and others are already 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. The next IASE Round Table will be held in Tokyo in August 2000, on the theme: "Training Researchers in the Use of Statistics". Regarding said theme, the IASE intend to respond to the demand expressed by researchers of numerous substantive disciplines who make ever more frequent use of statistics for their quantitative research. The choice of Carmen Batanero, who proposed the theme, was received favourably by the Executive Committee 1997-99, who delegated the organisation of the meeting to her .

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». In 1998, ICOTS V was successfully held in Singapore. The materials presented at the fifth ICOTS contributed to strengthening how important the teaching of statistics is from didactic and pedagogic view points, for furthering those individuals skills needed in a modern society. All of which is the result of ever more intent and deeper studies and research in the field of statistical education. But there was also another equally significant contribution coming from the keynote speakers, particularly from those in non-academic areas. The need for quantitative information and its ever wider use by governments and in economics were put in great evidence as well as the fact 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. The conference was a success, both from a scientific and organisational point of view, as the three volumes of proceedings - the first carrying the IASE

logo - made available to participants at the meeting, along with the participation at the Conference of about 400 delegates from 40 countries, show. The Executive Committee 1997-99 has decided to hold ICOTS VI in South Africa, in Durban in 2002. The choice of South Africa is proving to be particularly appropriate, since South Africa is introducing new school curricula for children aged 6-15, and this curricula also includes the teaching of statistics within the programme of mathematics. The proposed theme of the conference is "Developing a statistically literate society". This theme stresses the fact that the Association target group is society as a whole, and not merely a small subgroup of statistical educators. More than this, many aspects of statistical literacy need to be analysed and clarified. So the theme of a "statistically literate society" is on the ground and, in coming years, it will be examined and discussed in many different way according to the different professional experiences of people participating in the debate.

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 and the Proceedings were published. In 1994 the Second IASE Scientific Meeting took place in Cairo, in Arabic, and the Proceedings were published in the Arabic language. IASE has presented a summary of its activities in other conferences with statistical education components, such as the Joint IAOS/IASS Conference. Aguas Calientes, México, 1998 (Ottaviani, 1998), IV Iranian Statistical Conference, Tehran, Iran, 1998 (Batanero, 1998), IV Conference of Latin-American Statistical Societies, Mendoza, Argentina, 1999 (Ottaviani, 1999) and VI Islamic Countries Conference on Statistical Sciences, Lahore, Pakistan, 1999 (Ottaviani, Batanero, 1999).

The IASE also has 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 8<sup>th</sup> International Conference on Mathematical Education (ICME); the *Proceedings of the 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.

Also thanks to the efforts of the IASE and its memberships, the increasing interest towards statistical education has 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.

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).

Particular mention should be made of 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.

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.

#### **4. SOME REFLECTIONS ON TEACHING/LEARNING STATISTICS**

Through research in statistical education, statistics has proved to be a “modern discipline” useful for developing precisely those skills required by the global world and the information society. Among the abilities needed in today's society are, in fact, applying a problem-solving approach, using technology, developing the skills required for collecting, organising and analysing quantitative data, and working with others in groups. The teaching of statistics is, among other things, capable of developing these abilities.

As has already been stressed, research into statistical didactics has clearly shown that statistics is particularly adapted to that theory of learning which is known as “Constructivism”. 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. Statisticians know that statistics is an ideal platform for this kind of approach. It could be said that the pedagogical advantage of starting by posing a problem provides a context for statistical concepts, and solicits queries to be solved by statistical analysis and statistical thinking. 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.

In statistics particular attention must also be paid to the special relationship between this discipline and the computer. The computer is indispensable for research but it is also important in the teaching of statistics. Here it is to be seen not merely as a tool for calculation, but rather as a means of acquiring concepts, of understanding these better and of knowing their theoretical and practical implications. With regard to the

process of teaching/learning the logic of statistics and subsequent aspects of applications, the attempt should be made to encourage the student to grasp the entire cognitive process of real phenomena, and start by formulating a problem, planning the study, collecting real data, go on creating the corresponding data set, preparing it for the analysis, producing the output results for the report, concluding with the crucial phase of interpreting the results obtained. Furthermore a technological environment allows statistics teachers to utilise other didactic strategies such as: modelling and simulation. Statistics teachers can use simulation to illustrate principles and techniques, to show the heuristic potential of methods and mechanisms, and to have the student undergo certain experiences in a controlled environment. Introducing statistics into teaching becomes useful also for the acquisition of a greater familiarity with this technological instrument. However, introducing computers in statistics teaching implies new didactic problems, the educational environment changes and a great variety of new didactic strategies are offered. All of which requires a lot of research about the best way to organise the teaching and about the finding of the appropriate assessment methods to evaluate student learning.

Working with data is a fundamental approach to constructing knowledge, as well as being the basis for statistical analysis, thus becoming an important discipline from the point of view of education and teaching. Statistics, which by its very nature is multidisciplinary and privileges the dialogue with data, facilitates teamwork among experts from various sectors and is ideal for the use of multimedia instruments. Of particular importance in the success of this kind of teaching is the choice of data made by the teacher for the students' use, which 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. However, perhaps this is a challenge which the statisticians have to confront, if they want to have and maintain a role in spreading statistics education in the wider society.

In fact, a very important problem for the development of teaching/learning statistics, particularly at school level, is that in general, pre-university teachers have never had "contacts" with statistics as a subject in their education courses. Statisticians generally think above all of mathematics teachers who are entrusted with statistics and probability teaching within the mathematics curricula, but they cannot forget that statistics is "transversal", and its interdisciplinary characteristics make its use helpful to geography, history, language, as well as economy and physics teaching. Perhaps, it would be worthwhile for statisticians to promote in a systematic way research in teaching statistics also in other discipline contexts. However, referring to the problems that teaching statistics involve for mathematics teachers, it is not possible to deny that statistics and mathematics are, in fact, different subjects. This diversity is logical, and inherent in that continuous comparison with reality, in the attempt to know and if possible, explain, which is the eternal spur of the statistician –of methodology, as well as of the applied statistician- but which does not touch the mathematician. It is always difficult to teach a rapidly developing subject such as statistics, but, as research

in teaching statistics has shown, it is especially difficult to teach stochastics for a number of other reasons as well, and difficulties appear even in very elementary concepts. Firstly, the very nature of statistics is contrary to the traditional deterministic culture of most mathematics classrooms (Steinbring, 1990). 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. The growing interest in the teaching of statistics, brought about by a world-wide information society and the socio-economic globalisation process, has produced great demand for basic training in this area as primary and secondary level statistics teachers frequently lack specific preparation. So, it seems necessary to have better prior training for teachers as well as 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.

## **5. THE IASE AND THE COOPERATION WITH DEVELOPING COUNTRIES: A PERSONAL VIEW**

To further statistical education in developing countries is one of the most important IASE concerns and the difficulties of this objective were highlighted by Prof. Vere-Jones in 1993. His paper was divulged when the first Executive Committee of the IASE was going to be established, while the ISI Education Committee was going to cease to exist. As Vere-Jones pointed out the IASE itself had some limitations. In particular its resources and revenues were minuscule, and its possibilities were limited by its being largely dependent on the voluntary efforts of dispersed membership with other occupations. On the other hand, he signalled some possible lines the IASE could follow to meet the objective: the recruitment and retraining of suitable statistical staff; the development of basic teaching materials, at school level and higher; the support to individual staff in universities or other teaching institutions to encourage statistical change; the recruitment of membership from the developing countries; the holding of international meetings in developing countries.

Since 1993, the IASE has, in fact, utilised those strategies allowed by its financial limitations, while the Association has shown to have the possibility to rely on a solid core of changing volunteers, capable of acting synergically in order to promote IASE objectives and goals where and when requested. This was the case with the organisation of the ICOTS in developing countries. In this way a substantial number of teachers, at whatever level, had the opportunity of participating directly in international programmes, with great potential for encouraging local development. Besides this, the consciousness that cultural and attitudinal characteristics may impede the promotion of statistical education has induced the IASE to give support and visibility to groups of local teachers or educators interested in teaching statistics. A local group has, in fact, a clear knowledge of what is locally needed and is able to choose from all of those materials,



experiences, researches that the IASE membership has developed and put at the disposal of the statistics teachers' community, eventually on the web. Particularly in transition countries, another strategy followed was to put the IASE in touch with the National Statistics Societies in order to encourage them to create a Committee and/or a local group in Statistical Education Committee, so making evident their willingness to commit themselves to the diffusion of teaching statistics. In this way the recruitment of members in developing and transition countries was encouraged and it is hoped that this will contribute to a successive increase in membership. The IASE has also launched a network system connecting people who share their professional interests. Six new discussion lists have been proposed about specific themes in statistical education. The topic groups were: teaching statistics by distance education; teaching statistics to research workers; technology in teaching statistics; teaching statistics in post-secondary settings; linking statistics teaching in schools with the outside world; linking official statistics with statistics teaching. By now most of these lists have been launched as e-mail lists.

It is generally necessary to admit that in whatever country the need of statistics education is felt only when some primary people's needs are fulfilled and the necessity emerges for an organised government system. Perhaps this is the reason why the IASE promotion of statistical education and culture is unlikely to be fully successful before a country is in a position to grasp how important, useful and worthwhile the spreading of the discipline is, and can find the way to financially support these views. Fortunately, there is a clear relationship between the better availability of efficient statistical information and economic development, as well as between improved statistical training and a greater efficiency in the production and interpretation of statistical information. All of this gives statistical education more than one chance.

## **6. CONCLUSIONS**

The accelerating ecological, demographic, economic and scientific transformations that reach into every corner of life have an enormous impact on the demand of statistical data, on statistical methodology, and on national and global statistical systems. This trend suggests a great growth in the interest towards statistical education in the near future. When the content of the field is closely analysed, its highly complex and diversified characteristics emerge. 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.

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. The task of the IASE in this context consists of encouraging the creation of local groups of statistical educators who, thanks to easily accessible co-operative links, can make use of existing materials

and researches already carried out on teaching/learning of statistics, and are then able to initiate new studies or new research on their own, taking advantage of international collaboration and information-sharing.

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