

**UNITED NATIONS STATISTICAL COMMISSION and
ECONOMIC COMMISSION FOR EUROPE
CONFERENCE OF EUROPEAN STATISTICIANS**

UNECE Work Session on Statistical Dissemination and Communication
(12-14 September 2006, Washington D.C., United States of America)

Topic (ii) Statistical literacy

**THE DIMENSIONS OF STATISTICAL LITERACY: CONCEPTUAL AND PRACTICAL
EVALUATIONS**

Invited Paper

Submitted by Statistics Finland¹

I. INTRODUCTION

1. Since the Second World War, statistical literacy has developed into an essential skill in a democratic society. Statistical information is used more and more because communities have grown, the market and global media pervade increasingly people's everyday lives, social networks are slackening, people are better educated to understand statistical information and technology makes it easy to produce statistical presentations. Given these circumstances statistical institutes rightly tend to want to present themselves as one component of the democratic process. However, compared to the volume of the flow of statistical information, people's capacity to receive and understand it seems inadequate. This means a problem for the producers of statistics. What can they do to increase the competence and ability to read statistics in society?

II. DIMENSIONS OF STATISTICAL LITERACY

2. A classic definition of statistical literacy was offered by Katherine Wallman in her presidential address at the meeting of the American Statistical Association in 1993: *Statistical literacy is the ability to understand and critically evaluate statistical results that permeate our daily lives - coupled with the ability to appreciate the contributions that statistical thinking can make in public and private, professional and personal decisions* (Wallman 1993). Wallman's definition still puts the emphasis on the crucial structure in which "understanding" must be coupled with the ability to critically evaluate data and appreciate what kinds of decisions can be based on them.

3. However, statistical literacy is a very multidimensional and complex talent. To analyse how to best promote it, statistical literacy has to be broken down to its basic elements. According to Gal (2002) statistical literacy has five knowledge and two dispositional elements. The knowledge elements are literacy skills, statistical knowledge, mathematical knowledge, context knowledge and critical questions. In simple terms the literacy skills mean the ability to read texts and documents and to combine different messages. Statistical knowledge means understanding the idea of variables and probability, and knowledge of the process of acquiring data. Mathematical knowledge comprises knowledge of basic mathematical concepts such as averages and the use of percentages. Context knowledge is knowledge of the preconditions of statistics, such as sources of errors. Critical skills mean the ability to question

¹ Prepared by Jussi Melkas, jussi.melkas@stat.fi.

statistical results. The dispositional aspects of statistical literacy are beliefs and attitudes, and critical stance. These dispositional elements build the inclination to activate the knowledge elements.

4. This presentation approaches statistical literacy from a somewhat different angle, although the contents of statistical literacy seem here to be about the same as Gal's. Compared to Gal's presentation we adopt a more practical way of thinking, which at the same time causes some loss of theoretical coherence. The presentation is based on the work done at Statistics Finland while developing customer training activities.

5. According to this work, statistical literacy consists of six components. The ability to search and find right and reliable statistics could be the seventh, but we exclude it from this discussion.

- **Social science concepts:** In order to understand and critically evaluate statistical reporting one has to master certain social science and economic concepts, such as inflation, unemployment rate and birth rate, for instance. The concepts are the heart of the measuring process, and dictate that what is being measured. If the reader has no knowledge of how statistical concepts differ from his everyday concepts, statistics cannot be properly understood and evaluated. One example of this is the debate that has gone on in many countries about the "right" measure of unemployment.
- **Statistical way of thinking:** The reader of statistics must understand the basic statistical elements, such as mean, variable and index. If you do not know how and why percentages are calculated, you will not get very much out of statistics. A critical reader of statistics also understands the difference between mean and median. Statistical reporting is full of different index figures that can have a direct practical impact on almost everybody's life. Landlords, tenants, pensioners or wage earners must accept the impact the cost of living index, for instance, has on their lives irrespective of whether they understand its calculation principles.
- **Presentation modes:** Statistical literacy requires interpretation of various types of presentations of statistical results, such as tabulations, graphics and verbal reporting. All presentation methods are full of conventions which the reader must be familiar with. Problems are most frequently encountered in connection with statistical graphics, but even the reading of a simple table is a fairly demanding task. Different ways of using words in reporting is important, too. Describing change in the unemployment rate with percentages and percentage points produces different results.
- **Research process:** Knowledge of the research process is also needed. In the media the process that has produced the results is often ignored as if the validity and reliability of the results could be taken for granted. It seems to be a basic hypothesis in the media that all samples are fully representative. However, a critical reader understands that no sample can tell an exact and nonbiased truth about the population. The reader must know what a good sample should be based on and how different aspects of data collecting can affect the results. For example, if the reader does not understand the effects that differences in the wordings of questionnaires can cause, he/she will end up confused by seemingly contradicting results.

6. In addition, the components of statistical literacy skills include:

- **Imagination:** One has to have the capacity to use critical imagination. This is something that the sociologist C. Wright Mills tried to define in the 1960s as sociological imagination. It is a capacity to see different statistical indicators as part of the same picture, to find connecting threads between different results. It is also a capacity to find different answers to statistical questions from those offered. It is a capacity to see behind the numbers. If you look at the third dimension of statistical literacy in Wallman's definition, it is just this skill it demands.

- **Carefulness:** Reading statistics requires a considerable amount of care. The competent reader of statistics always cross-checks - between rows and columns, between tables, figures and text, between one report and other reports, and between exception and rule.

III. PRACTICAL SOLUTIONS IN STATISTICS FINLAND'S TRAINING ACTIVITIES

7. There are two ways a producer of statistics can promote statistical literacy: 1) by educating people and 2) by making statistical results as easy to understand as possible. In the following I will concentrate on the former, but will also touch on the latter at the end of the presentation.

Statistical institutes cannot assume the sole responsibility for all advancement of statistical literacy in society. The main responsibility has to rest with the general school system and universities, but education systems seem to have had difficulties in teaching this subject. One reason is that the subject is so scattered over different disciplines, such as mathematics, history, geography, social sciences and macro and micro economic theory, philosophy, methodology, and so on. Another reason may be the traditional way in which statistics is taught, which makes it very difficult for students to understand. The breakdown of communication between the sciences and the humanities (the "two cultures" defined by C.P. Snow) still prevails in attitudes, too. Therefore, if they want their products to be understood, the producers of statistics must be prepared to provide at least some teaching in statistical literacy.

8. Statistics Finland uses two main channels for educating the users of statistics: charged courses of lectures and free teaching material published on the web (eCourse in Statistics). In addition, we organise a variety of meetings and seminars with diverse user groups, such as journalists and teachers. A more thorough presentation of Statistics Finland's educational activities can be found in the paper "Towards customer-oriented training at Statistics Finland"

(<http://www.unece.org/stats/documents/2006.06.ces.htm>).

Sample titles of Statistics Finland's courses on different components of statistical literacy

	Lecture courses	eCourse in Statistics
Social science concepts	Courses on topical themes, e.g. "Elderly people in Finland"	"Demographic and population statistics", "Labour market statistics", "National Accounts"
Statistical way of thinking	"Statistics for journalists"	"How to read and use statistics", "Introduction to statistical thinking", "Indices"
Presentation methods	"Statistical graphics"	"Statistical graphics", "Statistical maps"
Research process	"Survey process"	"Introduction to statistical thinking"
Imagination and carefulness	Exercises of multiple format courses	Exercises of different courses

9. According to the received feedback these activities have been quite successful, but they are not the ultimate solution to the promotion of statistical literacy. Lecturing is by definition restricted to very small audiences. The eCourse channel reaches a wider audience but the process of learning is at least partly uncontrolled. The users are mainly those already interested in statistics. Most of the people who really need to improve their statistical literacy skills never visit our website. In addition, there is a huge variety among the users of the web and it is difficult produce material to suit them all. Based on the feedback we can estimate that our eCourse is best suited for students at the upper secondary and higher levels of education. There is a clear need to develop more elementary contents and presentations for the needs of less educated people and students.

10. Although both channels aim towards education in all areas of statistical literacy, the main focus in the eCourse is on the basic concepts of social sciences and economics and this role seems to suit it quite

well. The lecturing seems to gain more students when its contents are of the methodological or practical kind. If the teaching is charged for, the basic concepts only seem to interest limited audiences. Exceptions to this are courses of lectures with heavily tailored contents for the needs of certain groups, such as professional communities or employers, or courses on specific current themes. (Many of the titles in the table relates to the lively debate that has arisen as the post-war baby boomers are approaching retirement age in Finland.)

11. Practical exercises are quite an important part of the process of learning statistical literacy. The eCourse includes a couple of exercises for each subject. We have also tried to organise so-called multiple format courses where the students are given some exercises to do as "homework" between lecture periods. The problem is that many students do not have the time or the patience to do these exercises. Perhaps the exercises should be made more interesting. The opportunities for interactive exercises in statistics should be increased, expressly in co-operation with educational institutes.

IV. TARGETING STATISTICAL LITERACY

12. The promoter of statistical literacy skills has to bear in mind a large variety of groups whose needs deviate from each other. The so-called audience of experts, in particular, is fragmented into small sub-groups, which calls for a strongly tailored approach in the devising of measures to improve their statistical literacy skills. I will next only concentrate on the upgrading of statistical literacy skills among **ordinary people**, because this is the most important area where education in statistical literacy is needed as far as the basic task of official statistics is concerned.

13. Looked at from a statistical institute, ordinary people are helplessly far away. Although the Internet has rapidly increased the possibilities for direct dialogue with them, there is a need for intermediaries who can pass on the skills. Because the intermediaries always give the information the context and adapt it according to their operating culture and interests, the producers of statistics must also have a strategy for the development of the operating cultures of these groups.

14. The group most often defined as the crucial one in efforts to reach ordinary people is **journalists** who pass on statistical information to the general public. However, from the point of universal improvement of statistical literacy a group that is even more important than journalists is **teachers** of educational institutes of different fields. The education system gives the basic skills for reading statistics while even at its best the media can only illustrate and expose problems in the interpretation of statistics – and, of course, themselves handle them professionally. A third group of experts that is important as far as ordinary people are concerned is that of economic and social scholars appearing in public. The weight of this group of "**intellectuals**" in determining the agenda of social debate has grown in step with the growth in the power of the media (at the cost of e.g. politicians).

15. I will now go on to elaborate on the hypothetical targets for the statistical literacy skills of the aforementioned four groups. The list was born in practical co-operation and is bound to need closer defining in a number of respects. Its aim is to demonstrate where the emphasis in the statistical literacy skills falls with each of these groups and how the producer of statistics must define his own role separately relative to each one of them.

A. Content of the statistical literacy of ordinary people

16. The demands imposed on the statistical literacy skills of ordinary people are actually not very great. It is quite sufficient if they can read the day's newspaper or follow the statistical topics of a television news broadcast and understand them, evaluate them critically and draw conclusions from them. The required knowledge capital could, for example, consist of the following:

- knowing roughly the meaning of 20-30 key social science concepts that are used in statistics (inflation, gross domestic product, unemployment rate, etc.)
- understanding how key statistical parameters (per cent with its derivatives, mean, median) are calculated

- knowing how statistical data are collected and understanding procedures related to sampling methods
- being able to read tables and statistical graphics without the help of text.

17. **The basic method for reaching ordinary people is to present data in a mode that is as simple and illustrative as possible.** Irrespective of whether the information reaches them directly or indirectly, this supports the ability to interpret statistics best.

18. The Internet has rapidly become the main medium people use for searching statistical information. When Finnish people of working age were asked where they would go to look for statistics if they needed them, 56 per cent said the Internet. Nevertheless, the Internet is not an easy answer. Making statistics available on the web has generated a new audience for them but one that is also divided by level of education. People seldom enter statistical institutes' websites in order to improve their statistical literacy skills. In most cases, website visitors come via Google or a similar search engine, and mindful of the need of a specific piece of information – often without any interest in the methodological problems that may be associated with the information. Designing an efficient and illustrative set of web pages is one of the biggest challenges national statistical institutes and international statistical organisations face in the immediate future years. It must be possible to offer statistical information illustratively even to those who do not understand the finer points of statistical concept definitions, and tempt them to discover the preconditions and limits of the information.

B. Content of the statistical literacy of journalists

19. So that they could mediate statistical information understandably to ordinary people, journalists, naturally, have a broader need for information. They should also have the ability to foster an analytic attitude to statistics among the general public. They should:

- know the social science thinking behind the most important statistics, as well as around 100 key concepts on which statistics are based (current account deficit, dependency ratio, purchasing power parity, etc.)
- be able to calculate statistical parameter figures independently
- be capable of assessing and analysing what kinds of problems collected or published data may contain
- be able to compile tables and statistical graphics.

20. Journalists very seldom have the time to explore in depth the material they handle and instead of theoretic mastering of the topic it is more important for them to understand matters intuitively. **The possibility for interactive working is especially important in the development of journalistic work.** For this reason, web pages should contain examples to support the reading of statistics and personal consultation should be made available when questions arise. For instance, Statistics Finland regularly helps members of the media to evaluate the representativeness of data from diverse surveys. Courses designed for other experts suit journalists poorly, for the emphasis during their training events falls on discussion and examples.

C. Content of the statistical literacy of teachers

21. Because getting teaching of statistics included as a separate subject in official educational curricula is highly unlikely, co-operation with teachers of different subjects should be intensified. In addition to the teaching of history, social sciences, geography and mathematics, reading of statistics could also be introduced in practical content examinations, which is the prerequisite of real statistical literacy.

22. To be able to equip their students with adequate statistical literacy skills, the teachers of subjects with relevance to statistics must:

- know the social science thinking behind the most important statistics, as well as around 100 key concepts on which statistics are based (current account deficit, dependency ratio, purchasing power parity, etc.)
- know the principles of statistical science on which parameter figures are based
- know how statistical data are collected and understand sampling methodologies and their scientific bases
- be able to compile tables and statistical graphics, and understand the advantages and disadvantages of various presentation modes.

23. **Teachers need the support of a theoretical framework, on the one hand, and well-thought out practical exercises, on the other.** The theoretical framework provides the tools for reacting correctly in problem situations in teaching. The ready, pre-designed exercises, again, are necessary because it is not easy to spontaneously devise statistical exercises that would illustrate precisely the desired matter. To support lecturing, it is worthwhile to produce background teaching material from the perspectives of a variety of fields.

D. Content of the statistical literacy of "intellectuals"

24. The experts, or "intellectuals" who appear in public are a group that statistical institutes find difficult to approach as they do not like to be taught. Nevertheless, the group is important because it shapes public opinion – either in the direction that supports statistical literacy or towards total indifference about it. **The main pursuit of intellectuals is dialogue and a producer of statistics can best influence them by getting engaged in the dialogue.** Co-operation with this group can be enhanced by setting up common discussion forums (examples of this at Statistics Finland are the "Welfare Bulletin" and "Knowledge & Trends" periodicals, to which articles are written by both statistical experts and other producers of information on society) and by participation in social and scientific debate based on the statistical institute's own scientific repertoire. Statistics Finland has also found that collaboration in the processing of survey data is useful.

25. The content of the statistical literacy of "intellectuals" consists of:

- understanding of the role of statistical information alongside other forms of information, as well as of the principles and central concepts of statistical systems
- knowledge about the principles of processing observation data into statistics
- experience in the research process and an overall view of empirical research methods
- ability to compile tables and statistical graphics, and understand the advantages and disadvantages of various presentation modes.

26. A summary of the means Statistics Finland employs in its efforts to promote statistical literacy skills in society in general and in particular among the key population groups described above is attached hereto.

V. REFERENCES

- Gal, Iddo. Adult's Statistical Literacy: Meanings, Components, Responsibilities. *International Statistical Review*, 2002, 70, 1.
- Mills, C. Wright. *The Sociological Imagination*. New York. Oxford University Press, 1976 (original title 1959).
- Snow, C. P. *The Two Cultures*. Cambridge University Press, 1993 (original lecture 1959).
- Statistics Finland. "Towards customer-oriented training at Statistics Finland". Paper presented at CES Plenary Meeting Paris 13-15 June 2006. <http://www.unece.org/stats/documents/2006.06.ces.htm>
- Wallman, Katherine K. Enhancing Statistical Literacy: Enriching Our Society. *Journal of the American Statistical Association* March 1993, Vol. 88, No. 421.

Statistics Finland's measures to support statistical literacy skills in various target groups

	Ordinary people	Journalists	Teachers (own home page on Internet website)	"Intellectuals"
Social science and economic concepts	Logical and easy search function on the Internet Links from statistical data to concept definitions in plain language	Databank of concepts accessible via the Internet Courses and days on topical themes for groups of journalists	Databank of concepts accessible via the Internet Ready teaching material produced in co-operation with educational institutes	Databank of concepts accessible via the Internet Possibility to participate in the analyses of Statistics Finland's data Possibility to write articles for Statistics Finland's periodicals (Welfare Bulletin, Knowledge & Trends, etc.)
Basic statistical thinking	Module of How to Read and Use Statistics of the eCourse in Statistics	Course of lectures on statistics for journalists	Tailored courses for diverse groups of teachers Ready teaching material produced in co-operation with educational institutes	Methodological seminars on various statistical topics
Research process	Methodological descriptions in plain language on the Internet	Course of lectures on statistics for journalists Methodological descriptions on the Internet	Course on the survey process and its material on the Internet	Articles in Statistics Finland's publications
Presentation modes	Clarity of statistical graphics and tables on the Internet	Course of lectures on statistical graphics	Course of lectures and lesson of the eCourse on statistical graphics	Course of lectures on statistical graphics
Imagination and carefulness in the reading of statistics	Exercises and quizzes on the Internet for those willing to learn	Statistical support service for journalists	Ready exercises complete with answers on the Internet	Provision of forums for dialogue in Statistics Finland's publications