A MULTIFACETED APPROACH TO INCREASING STATISTICAL LITERACY IN ITALY: THE WORK OF THE ISTAT TERRITORIAL NETWORK

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Promoting statistical literacy is one of Istat (Italian National Statistical Institute) key activities. The constitution of the "territorial network of experts in promoting statistical literacy" (a staff of more than 80 specialists distributed through Italian regions) has given further impulse to disseminating activities. Approach is multidirectional: methodological advancements have been realized in various fields and new procedures have been introduced both to systematize and standardize existing projects and to extend the use of the best practices. More than 500 activities were concluded between 2013 and 2015, with around 40,000 subjects reached. The target is represented mainly by teachers and students at secondary and tertiary levels. Actions are continuously assessed and improved on the basis of feedbacks. Network infrastructure, materials and actions realized are discussed. A specific care is devoted to the measurement of activities impact.

INTRODUCTION

Our modern society is characterized by the development of the internet. In the last 15 years, for instance, the internet penetration rate of the Italian population with 6 years and more has more than doubled: from 27% to 60.2% in 2015 (Istat, 2016). In the last year, the layers with the highest penetration rates (over than 80%) are those of young (11-17) and young-adults (18-34).

In this technological and cultural framework the production and dissemination of data is growing exponentially. According to recent estimates (Josh, 2015), in 2015 in the world more than 500 million tweets and 4.3 billion Facebook messages were posted every day.

The only way to protect ourselves from this data deluge is to become able to discern the appropriate *official* sources and to be aware that the most part of the so-called *media-produced* statistics is of dubious quality and probably misleading. This is a sort of *revolution*, a long-term cultural process that has to be fostered and sustained by National Statistical Institutes (Wallman, 1993; Unece, 2014).

In the international context the most important plan aimed at this scope is the International Statistical Literacy Project (ISLP), carried out by the International Association for Statistical Education (IASE), the education section of the International Statistical Institute (ISI). ISPL promotes statistical literacy activities of different organizations in the world and informs the world about them. In addition, this organization creates activities and actions able to help the increase of statistical literacy awareness. The main target groups involved are citizens, media, educational institutions (secondary school and upper secondary school-age students), universities, research institutions, decision-makers, libraries, and national statistical agencies. Usually, each agency is specialized in some aspects (Ferligoj, 2015): for instance, Austria tends to improve statistical literacy in schools, Canada is adopting a strategy that combines traditional and innovative communication practices to improve the media communication; USA is adopting an approach based on the Census at School.

Italy is member of ISLP and Istat has been pursuing the goal of disseminating statistical literacy for many years (Giacché, 2008; Giovannini, 2013). Activities of Istat are peculiar if compared with the other national statistical agencies. In effect the approach adopted by the Italian institute in order to contribute to strengthen understanding of statistics about society is multifaceted, oriented to a multiform target. Various actions were realized on the occasion of the two last census rounds: "Census at school" in 2001 (Lombardo & Conti, 2003) and "Let's play at census!" in 2011 (Da Valle & Valentini, 2013). In addiction multiple events have been proposed for different targets (Istat, 2006; Peci & Sterzi, 2007; Lombardo & Zuliani, 1998).

A particularly significant innovation was the constitution, in 2013, (Valentini et al, 2015) of the *territorial network of experts in promoting statistical literacy* (NPSL, since now); NPSL is composed by a staff of more than 80 people (each one dedicated to the project for around 20% of

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his/her working time). NPSL components have a dual role: 1. to produce materials and multiway strategies for different targets; 2. to disseminate statistical literacy in the territory on the basis of introduced materials and strategies.

During the first three years of activity (2013-2015) the network realized several projects and distributed 35 teaching packages for students of schools and universities. Moreover 501 on-field activities were carried out: 50% for students (of primary and secondary level); 20% for university (college) students; 10% for teachers; 20% for other targets. NPSL was also able to give a *renewed* impulse to dissemination actions thanks to its ability to rationalize and systematize previous experiences, to develop innovations, to encourage the dissemination of good practices and – last but not least – to spread optimism.

The paper illustrates the role, the activities and the organization of NPSL.

METHOD

The organization of NPSL is quite complex because it has to take into account various constraints at the same time. At first, it requires the full integration between activities for disseminating statistical literacy and the mission of Istat. Moreover, projects and targets are differentiated and need different specializations. In addition, there is the problem of logistics: personnel is geographically distributed in 18 different seats (Istat Territorial Offices, that are situated in all the capitals of Italian regions, not including Valle d'Aosta and Trentino-Alto Adige). The operating network is designed to take into account all these peculiarities, as shown in Figure 1: on the left (part a) the infrastructure of NPSL; on the right (part b) the monitoring system of activities.

The coordination of the whole system is realized combining resources and objectives by means of thematic working groups (8 in total): survey of experiences, standardization of materials, projects for schools, extra scholastic projects, test of materials, monitoring, assessment, transversal activities. Logistics difficulties are solved using a specific web community (a sort of social network) and through an intensive recourse to web-meetings.

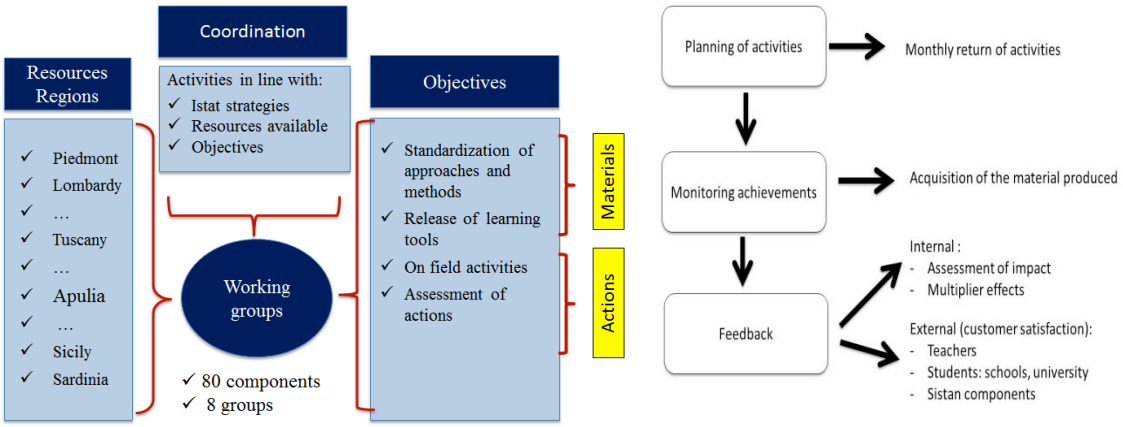
The unique goal to promote statistical literacy is reached using a multifaceted approach, thanks to the combination of four strategic objectives, each of which subdivided in various steps:

- [1] *Standardization of approaches and methods*: materials collected in the various territorial offices before the institution of the network were produced independently. Aim of NPSL is to standardize approaches so that it may be possible to realize economies of scale. Materials produced for pre-2013 initiatives are englobed by the network, catalogued and then released on a specific database (DB_Prod). DB_Prod contains more than 300 resources accessible to all network operators in an easy and free way
- [2] *Release of learning tools*: aim of the network is to produce and release on the Istat web-site a set of learning materials for students of different types of schools (primary, lower and upper secondary) and also for university. All materials were tested before the publication.
- [3] *On-field activities:* a goal of NPSL it to propose on-field actions to engage the various targets. Dissemination of good practices is supported in order to share projects and initiatives which might be replicated in various contexts.
- [4] *Assessment of actions*: the network is based on a continuous quality improvement. With this purpose, each on-field action is evaluated both internally and externally. The internal evaluation is subjective; it is based on the judgment of the Istat representative. The external feedback is based on the assessment of participants to the events.

On the basis of the organization adopted, the perceptible results of the network activities are of two types: *materials* (originating from objectives [1] and [2]) and *actions* (objectives [3] and [4]). Materials and actions are closely linked: in most cases the push of an initiative is the launch of materials produced by the network and vice versa an event could be the occasion to illustrate and disseminate new products of the network.

Materials are measured in terms of packages released (for students of schools and university) and in terms of adequacy of packages for the different categories of students according to specific tests. Actions are accounted in terms of numbers of on-field activities carried out and in terms of the participants' judgment. To monitor actions, each activity, carried out by the network,

is planned and monthly monitored. Moreover, produced materials are uploaded to DB_Prod. Each event is subjected to both internal and external feedback. Internal feedback consists in NPSL operator judgment and in the estimate of the *multiplier effect* (the number of further events that an action is able to stimulate). External feedback is the judgment of participants regarding organization, materials, content and general aspects.



a) Infrastructure b) Monitoring system

Figure 1. Organization of NPSL

RESULTS

In the first three years of activity the production of NPSL has been conspicuous in terms of both materials and on-field actions. Materials planned and completed for students of school and university consist in 35 packages. The themes treated are in line with the existing framework for school curricula and the language adopted is differentiated to take into account all the different stages of education (Caporrella et al, 2014). Table 1 shows in greater detail the list of packages for students of high school (a, left side) and of university (b, right side).

Materials for secondary school level are organized in the form of tracks (slides in PPT and in PDF, technical guide for teachers). The common thread is to sensitize students to the proper use of statistics in everyday life, to provide them with a method in order to improve the understanding of data and statistics related to emerging socio-economic phenomena. The educational path starts from an introduction to official statistics. An in-depth analysis concerns the representation of data, the questionnaire design and the labor market. As an example, the module *how to read data* introduces to statistics in a way which is, in the meanwhile, funny and rigorous. Packages are also translated into German thanks to the cooperation with ASTAT (the statistical institute of the Autonomous Province of Bolzano) to preserve the bilingualism of the area. Materials are exposed in the institutional website of Istat (www.istat.it), *Under 21 area.* A quite realistic estimate of the number of accesses to Under 21 area is of around 200 thousand in the biennium 2014-2015. Before the release, packages are tested in some sample schools according to a test-protocol targeted both to teachers and students. Results of 2015 are solid: on a scale between 1 and 10 the overall judgment of teachers is 8.8 (more in-detail effectiveness of communication is 8.3; adequacy 8.5; utility of materials 8.8; integration of learning content for teaching 8.9). Judgment of students is slightly lower: the overall opinion is 7.9; in greater detail the interest in the topics covered is 7.3, the utility of materials is 7.7, the utility of packages for school 7.7 and the utility of packages for everyday life 7.0.

Materials for university students are meant to be as support tools for conducting lessons and seminars by professors. The main features are: flexibility (materials are useful for all degree courses), self-explanatory (students can use materials also without the support of the teacher) and hyper textual (with many links to other detailed documentation and websites, glossary and bibliography). The covered topics stretch from the path of official statistics and surveys to various aspects of data dissemination. A special focus is given on socio-demographic profile and on measures of inflation. Themes are consistent with the results of the pilot survey on *Statistical requirements* internal to the university courses of study. The survey was carried out in 10

universities to 63 coordinators of degree courses selected in a semi-random way. Materials are tested before the release on the basis of a specific protocol. Test results on the various aspects of packages (effectiveness of communication, language adopted, balance between theory and practice) are positive: in the scale between 1 and 10 the judgment fluctuates around the level of 7.5 for both the 20 professors and the 40 students that tested the materials. Tools are available in a page of the platform of *Statistical training* (https://formazione.istat.it/moodle).

A completely innovative material is that prepared for *deaf people* implementing a pilot video-language vocabulary in Italian Sign Language (LIS). This project is part of the information contained in the Convention on the Rights of Persons with Disabilities UN, to which Italy has joined ratifying with a specific protocol. The first two videos realized are on: i) basic concepts of statistics; ii) indexes of position and variability.

Table 1. Statistical packages for secondary and tertiary students

a) Packages for secondary students	b) Packages for tertiary students
Introductory course to the official statistics - Istat activities - Statistical surveys - Diffusion of official statistics - How to read data - I.Stat: Istat data-warehouse *Course: statistics and the labor market* - Sources and definitions *Corse: the representation of data* - Tables - Figures - Age pyramids *Course: the questionnaire* - Goals of the questionnaire - Administering methods	*Introduction to official statistics and to statistical surveys* - Official statistics and Istat activities - Introduction to data quality and statistical surveys *Istat and data diffusion* - The diffusion system adopted by Istat - I.Stat: Istat data-warehouse *Census of population and housing* - Shifting from traditional to continuous census *Representation of some phenomena* - Socio-demographic profile of Italy (at 2011 Census) - Inflation: what is it and how it is measured - The recent dynamics of inflation in Italy

The production of NPSL in terms of actions consists in on-field activities to disseminate statistical literacy on the basis of targets of the various territories: students, teachers, civil servants and more in general the whole society. From March 2013 to December 2015 the network carried out 501 events: 149 (29.7%) in the last 10 months of 2013, 187 (37.3%) during 2014 and 165 (33%) during 2015. At the end of each event the organizer has to report the activity by fill-in an on line form with the following information: typology, length, number of participants, linkage with other events and so on.

A typical event lasted slightly more than 4 hours. The average number of participants was between 40 and 80. Events were often held in cooperation with other institutions (mainly universities and members of the national statistical system), in most cases (32.2%), in the form of seminar-meetings (23.1%), training courses (17.6%) or laboratories (14%). A specific care is devoted to students and teachers of secondary schools (33%) and to university students (20%). Among the various activities, projects to develop teacher statistical skills are of primary interest: many courses have been organized in order to allow educators to manage statistics as a useful tool for society.

The attitude of each event to generate other events can be estimated calculating the *multiplier effect*, which is the ratio between the number of events linked to other events (already completed) and the total number of events. Globally, the multiplier effect was of 0.65: this means that 100 new events are able to generate other 65 events. The multiplier effect was higher in the case of laboratory: 0.75.

Moreover a web community of teachers (named *Sharing experiences between Istat and teacher)* was launched. The number of participants is of around 300. The community is organized into three areas: i) educational materials produced by Istat; ii) microdata analysis; iii) use of virtual environments. The last approach appears very interesting to raise the interest of students.

For a subgroup of events (20.1%) a customer satisfaction survey was implemented in order to assess the main aspects of the initiatives. A questionnaire was sent to the 1,736 participants (35.8% secondary level students, 30.6% university students, 30.2% teachers, 3.4% civil servants

(components of the Sistan). Table 2 shows the main results of the survey for the 1,149 respondents (66.2% of the total). On a scale between 1 and 5, the global agreement was of 4.3 for teachers and civil servants, 4.2 for university students and 3.5 for secondary level students. The lower evaluation attributed by students is confirmed by differences in the agreement of more detailed aspects.

Table 2. Agreement of participants to on-field initiatives (scale from 1 to 5)

Investigated aspect	Subject			
	Teacher	Secondary level students	University students	Civil servant (components of Sistan)
Global agreement	4.3	3.5	4.2	4.3
- General aspects	3.9	3.2	3.9	4.0
- Organization	4.7	3.9	4.1	4.5
- Contents	3.9	3.4	3.9	3.8
- Materials	4.1	n.a.	n.a.	3.9

n.a. = untreated in the questionnaire

Each of the 501 actions fulfilled in the different territories has its own peculiarities linked to local experiences, staff skills and statistical permeability of the various areas.

A first typology of action is addressed mainly to train teachers of all school levels, often with the partnership of universities. Items treated are those of scholastic programs. The activities are carried out through a mixed methodology: in presence, streaming, through a specific community. In some cases courses are specifically addressed to train teachers in order to help students to correctly answer *Invalsi* tests. Invalsi tests are questionnaires deserved to all students of the 2nd and 5th year of Primary school, of the 3rd year of Middle schools and of 2nd year of Upper School in order to assessing their skills and knowledge in various areas of Mathematics and Italian. The statistical part of Invalsi tests is the area of Mathematics named “data and forecasts”.

Various actions are straight directed to students. This is for instance the case of *statistical weeks*, for primary and secondary schools, in which students approaches the themes of statistics in a playful and fun way through a sort of “game of the goose”. Quite similar is the idea of *statistical open-day*: an initiative conducted in some high schools where statistics is presented in the form of game (“Who wants to be a statistical?”).

A different approach is followed in the case of *welfare of teenagers*: a research project aimed at testing a system able both to increasing statistical literacy and to detect and "measure" the subjective well-being of teenagers using an online questionnaire sent to students of the secondary schools.

Finally, two further cases are of specific interest in this framework as concrete examples able to offer younger generation conceptual tools to better understand quantitative aspects of society and to give them instruments towards critical thinking. The first experience, for students of high-schools, is that of Apulia; the second, for university students, is that of Tuscany.

In Apulia, NPSL experienced *micro-data laboratories* with students of the secondary school in two subsequent school years (2013/14 and 2014/15). The logic behind laboratories is to orientate students in the world of data in order to give them instruments to extract relevant information. The operative steps of laboratories were the followings: 1. Analysis of metadata; 2. Download of microdata (drawn by Istat: microdata for public use); 3. Adoption of a gnu license software for microdata treatment (software PSPP); 4. Production of a report with survey results (including tables and figures).

The experience of Tuscany was addressed to over 10,000 first-year undergraduate students of the three universities in the region (Florence, Pisa and Siena) with a twofold objective. The first aim was to promote statistical literacy with an intriguing e-mail sent to all students; the second aim was to *assess statistical literacy* making use of a simple questionnaire linkable from the e-mail. The assessment form is mainly addressed to the use of statistics for daily life and not to statistical formulas. Response rate was of 31.9%. The mean level of statistical literacy was of 6.4 points (± 0.04) in the range between 0 and 10 that is a signal for a scarce level of statistical literacy. A statistically significant difference appears between the various individual covariates (course attended, gender, school curricula). In the case of gender the measurement is higher for male (7.0 ± 0.05) vs. female (5.8 ± 0.05). For the school curricula the level of statistical literacy is more

elevated for students that attended lyceum (6.5 ± 0.05) or a technical school (6.4 ± 0.08) and for students with a very high final grade (98 – 100): 7.3 ± 0.08. The knowledge of differences is a key factor for a better allocation of resources.

CONCLUSION

Activities of the Italian network for promoting statistical literacy show that disseminating efforts have to be multidirectional and not only limited to one intervention tool. A multi-level strategy will in fact be able to fulfill in the meanwhile different targets and the different awareness of each target. According to this guideline, the network's philosophy is to take up a concept of *collective intelligence* (Nguyen, 2013). Local experiences are analyzed and, if considered of interest, standardized, included in the system and re-launched in larger contexts. The use of web tools for the interconnection between components of NPSL facilitates the interchange of knowledge. Each local node of the network becomes receptor of needs and facilitator of new initiatives. The quality of materials and initiatives provided is ensured by the continuous feedback originating from the monitoring system.

The dissemination path, however, is rather far from completion. As emerged from an experimental survey carried out in Tuscany, the level of statistical literacy for university students is scarcely sufficient. Moreover it depends strictly on each individual high-school performance. It is therefore necessary to consolidate the results achieved with the institution of NPSL by expanding the number of products and by focusing on new tools able to capture the attention of young generations, like, for instance, the use of virtual reality. Specific attention should also be devoted to the enhancement of courses for teachers, for their positive effects on children.

In the case of university students, it should be useful to strengthen the line to suggest seminars on official statistics and laboratories on micro-data treatment. The recent participation of Italian NSI to European Master on Official Statistics (EMOS) is a signal of this interest. The new release of the Istat platform for statistical training is a further step forward along this guideline.

It is further necessary to consider the possibilities offered by the Italian legislation on the so-called *alternating training-job* that is a new method of connection of the school with work. The project consists of a period of students' training in enterprises or public offices in order to experience a work situation. It is based on the construction of pathways designed, implemented, monitored and assessed, under the responsibility of the school. Alternating training-job implies around 500 thousand students of high schools for an individual period of training ranging from 200 to 400 hours in three years. The project is potentially interesting as a vehicle to disseminate statistical literacy by setting up *virtual training firms*, leaded by high school students, whose main scope is to train younger colleagues on statistics under the supervision of NPSL network. The potential of this system is virtually limitless in case in which university students of statistics are placed at the top of the chain. This approach has already been successfully experimented in Campania with very promising results and it deserves to be further investigated.

Finally, Istat is working to involve the Italian Ministry of Education in order to sign a memorandum: the memorandum could allow a homogeneous approach with all educational communities and the implementation of further scale economies.

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