

“Catch me if you can”: How to help young generations to be statistically literate?

Svetlana Badina, Statistics Norway, Svetlana.Badina@ssb.no

Abstract

Modern society is characterized by the wide usage of information technologies and social media among young generations. Reliable statistics are an important tool for understanding the world around us and as a basis for critical thinking. Statistical illiteracy and a non-critical approach to data, numbers and statistics can potentially affect young generations' approaches to the future solution of global problems.

To meet this challenge, Statistics Norway has made a strategic choice to have secondary education students, as a target group for adapted dissemination of knowledge about the value of using official statistics for the society. We reach students by approaching schools and teachers.

Statistics Norway wants to encourage students to be critical to the huge volume of information they have access to, and to get familiar with official statistical sources, in an adapted manner. At the same time as tuition needs to be suited for students who have an average engagement in statistics, and for students who might find this subject difficult, school curriculum about statistical methods may be too scarce for the most engaged and curious students. Professionals from statistical agencies can assist in filling competence gaps in a rapidly changing world, and to build an important bridge between theory and practice.

Building on experience from and following the examples of assignments in the European Statistics Competition in 2021 and 2022 we have developed and started testing teaching material in survey methodology. The material includes creative assignments based on surveys being conducted in Statistics Norway. Further, Statistics Norway has increased efforts to produce teaching material about statistics and analyses for various topics, and to communicate with teachers about them.

In this article, we provide an overview of the recent achievements and current challenges in Statistics Norway's efforts to help young generations be statistically literate.

Keywords: statistical literacy, critical thinking, survey methodology, curriculum, teachers, school students, user contact, adapted teaching material.

Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write.”

H. G. Wells.

1. Introduction

Statistical literacy is the ability to understand and reason with statistics and data (Wikipedia.org). Arguments that use data, are necessary for citizens to understand different types of material presented in varied publications and channels. Some understanding of the statistical technique of sampling is necessary to order be able to correctly interpret and understand results from surveys. For these reasons, and others, many programs around the world have been created to promote and improve statistical literacy (Townsend, 2003). Many official statistical agencies have programs to educate students in schools about the nature of statistics¹.

So, what does it involve being statistically literate? Good understanding of statistics means, among other things, that one can read and understand tables, graphs, diagrams, be able to assess the information contained in statistics, can see connections between different statistics, have knowledge of basic concepts and methods in statistics, have knowledge of the methodological aspect in the statistics, from definitions of what is to be surveyed to how data is collected, processed, and disseminated (Bore et al, 2007).

In this paper we aim at giving insight into how Statistics Norway works to help students in lower and upper secondary schools be statistically literate. We give an overview of our efforts to produce teaching material that is useful for the teachers and interesting for the students. In the discussions we aim to answer these questions:

- Why do we want to reach young generations?
- How might we engage teachers to get insights into their needs and ensure that what we produce is relevant?

¹ <https://ssc.ca/en/statistics-literacy>,
<http://www.stat.ucla.edu/~jsanchez/books/Paul-Taylor-1.pdf>

- How might we get the attention of students who are engaged and curious about statistics? How do we reach different personalities, backgrounds and learning preferences?

The paper describes the teaching material developed, teaching activities and the experience we have gathered so far. Our experiences and insights may hopefully serve as inspiration for other statistical offices.

2. Why SSB school? The explanation of our mission

Official statistics are the nation's shared factual basis. This is crucial for a well-functioning democracy, and the statistics are thus a public good that everyone should have equal access to. Statistics Norway's statistics, research and analyses shall contribute to insights about societal development, form the basis for public discourse and facilitate informed decisions (*SSB, 2021*). Statistics Norway aims to be the leading supplier of facts about Norwegian society, and we shall ensure that our products and services are adapted to different target groups.

It is challenging for everyone to navigate in the huge amount of information and the diversity of information sources. The school sector is also changing rapidly. Textbooks that have had a privileged status historically, are being replaced by other information sources and teaching material. The new normal is digital sources, and hence the statistics provided by Statistics Norway is a much-used source for students and teachers (*Nickelsen, 2021*).

The last annual user survey for *ssb.no* users (*Bjørnstad, 2021*), where among others about 700 teachers and students answered, indicates that they are more inclined to look for information about a topic than the average user when visiting *ssb.no*, see Figure 1.

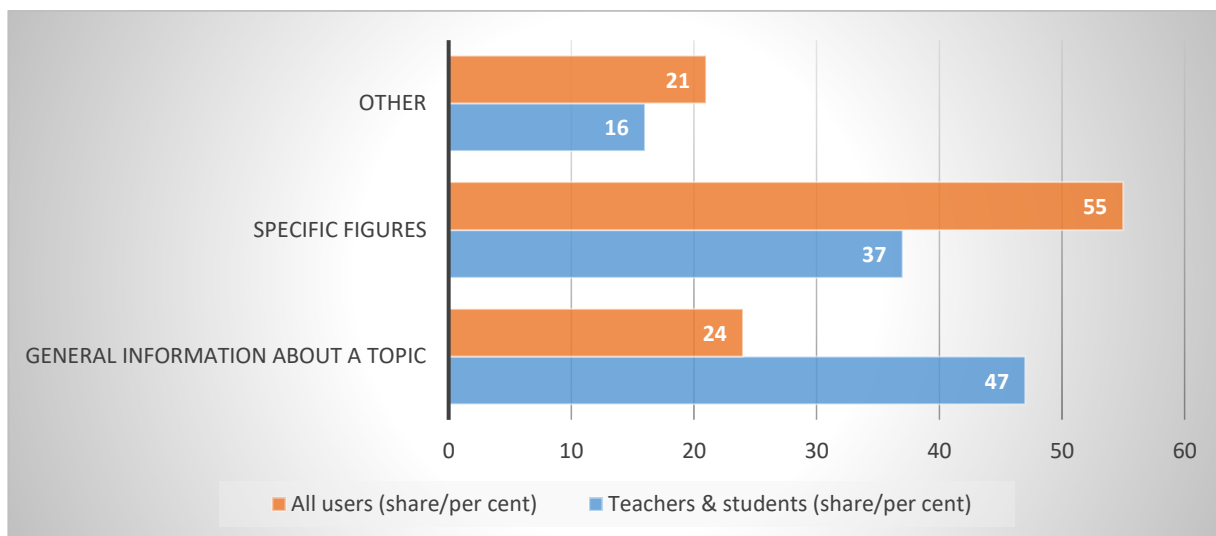


Figure 1. The main purpose for visiting ssb.no (Bjørnstad, 2021).

This might indicate a need for teaching material about specific topics, not only specific statistics.

Statistics Norway's initiative to reach teachers and students, is called SSB school. The initiative aims to communicate statistics and analysis in a way that is easily accessible, clear, and engaging.

SSB school is interdisciplinary work. The team consists of staff from different departments and have supplementing competences (statistics, communication, pedagogy). The work has been done within our own budgets without any additional funding so far. We have spent between 0.5 and 1 person-years in recent years, including the time spent on the European statistics competition.

The subject renewal 2020 (school reform)² emphasizes the fact that all school students should be able to go in depth in the subjects, also as a part of being trained in critical thinking and scientific methods. In addition, interdisciplinary topics and work is emphasized. This subject renewal implies that students and teachers must work in new ways (Nickelsen, 2021).

Through collaboration with schools, statisticians have an opportunity to reach out to a younger target group with their competences. They can contribute to more

² <https://www.udir.no/laring-og-trivsel/lareplanverket/fagfornyelsen/>

effective and motivated learning and understanding of relevant topics by helping teachers to have interesting and “close-to-the-real-world” teaching material³.

Pedagogical research shows that the students’ inner motivation (Wæge and Nosrati, 2008) is stimulated by realistic contexts and usefulness for the students’ everyday life. Relevance provides motivation, motivation provides better learning and Statistics Norway can contribute with relevance.

Professional environments can help teachers choose relevant contexts and show how numbers and statistics can be useful in daily life. They can help make teaching more exploratory, relevant, and evolving. We can provide teachers with tools to satisfy three basic needs of the students’ motivation for learning process: competence, autonomy and belonging⁴, and contribute to promoting positive experiences of learning, enjoyment, and understanding. This in turn, leads to motivation which in turn encourages learning.

Students represent a heterogeneous group in terms of personalities, interests, cognitive profiles and learning preferences. Of course, Statistics Norway doesn’t have the resources to ensure that the teaching material is adapted to all students. However, we can offer examples that can inspire and perhaps meet the different students’ profiles and cognitive styles. When teachers are able to satisfy core students’ needs and to select suitable teaching strategies, they can “catch” more youngsters effectively (Vinje et al (2021)).

The way SSB-school works to help teachers is: 1) to understand and to know competence aims and learnings goals in different subjects, 2) to understand how teachers work with the curriculum and 3) to provide teaching material.

3. The teachers – a key group for reaching the young generation

Dedicated web pages, [comprising differentiated teaching material](#), are an important part of SSB school. Our prime target group for SSB school is teachers in

³ The Norwegian Parliament, The Norwegian Broadcasting Corporation, Human Rights Academy, UN Association Norway have already developed different teaching materials.

⁴ More about three basic needs for motivation for learning is here: Wæge Kj., Nosrati M. 2008, *Motivasjon i matematikk*. Universitetsforlaget, Oslo. Competence (feeling of mastery), autonomy (investigative activities and open assignments), belonging (feeling of having a good and safe relationship with other students).

lower and upper secondary schools. SSB school has separate web pages for two levels respectively. In addition to these pages, SSB school comprises pages with visualizations in charts and maps for selected topics, and relevant videos. But how might we engage the teachers in developing SSB school, and get insights into their needs?

Until recently, our contact with teachers has been concentrated on the use of official statistics via our Statbank, as well as on promoting and engaging in the European Statistics Competition for schools. The Statbank provides dissemination of data in datafiles, tables and charts. In the years 2019/2020, 2020/2021 and 2021/2022 between around 200-350 teams from Norwegian schools participated in the national part of the European Statistics Competition⁵. So, these efforts have indeed been important and have provided a gateway into a rather broad contact with teachers, and as a result with students.

At present we are in the start-up phase in broadening our general contact with teachers. We do the following to learn more details about the teachers' needs, and engage teachers in developing SSB school:

- the course in survey methods for teachers was presented at a math teachers' forum (digital meeting in March 2019),
- arrange meetings with teachers where we present and discuss our plans, their needs, and the way forward in the development of SSB school (last held in January 2022),
- send newsletters about relevant statistics and new teaching materials to a network of teachers,
- provide assistance to teachers who contact us for help,
- aim at establishing a wider group of teachers who can support us in improving our teaching material in SSB school.

We wish to have a systematic approach to the testing of the relevance of our tuition material. The teachers give us valuable information about topics which they would like us to create tuition material about, as well as views on what we already have provided. From the discussions, it seems that a good mix of interactive online-

⁵ <https://www.esc2021.eu/>

material, exercises where students can use Excel (and even Python) and booklets for print, is on demand. The teachers also expressed that a course for them, for finding statistics on ssb.no would be of a great value. Our website is comprehensive, and it might not always be easy to find what you look for. With regards to topics, the teachers expressed an interest in more teaching material within social studies, and issues like earnings, income, social disparity, and economics. Further, they expressed a need for teaching material about survey methods, with an adaptation for the examples, to design these 'near' to populations that students relate to. For instance, teaching material about sample surveys might be designed around how to carry out a sample survey for a large school.

In the last user survey, some of our users agreed to participate in a user panel. Hopefully, contact with such a panel of teachers, together with already established contact with teachers and students, will enable us to develop SSB school further, and to provide the schools with teaching material that enlighten the use of official statistics.

A reflection is that establishing and maintaining contact with a user group as varied and comprehensive as teachers (and their students) is challenging regarding resource use, skills, as well as teachers' limited time.

4. Teaching material about relevant topics, official statistics, and survey methods

So far, we have disseminated teaching material or courses about five different topics in separate webpages for schools, with three more to be released shortly. To make sure we provide the teachers with subject material that they find relevant for all students we:

- use the official curriculum for various subjects and decide which of our statistics and analyses can contribute to the achievement of the competence aims.
- apply central principles in pedagogy in our teaching material. We differentiate the teaching material and provide a varied and adopted content.
- track what events and topics that are high up in the news agenda in Norway and internationally now and in the coming months.

- draw on the insights from the last user survey about ssb.no, and user contact with teachers.

The curriculum is a key in driving our production of teaching material. The curriculum for each subject comprises both the competence aims and assessment criteria for each subject, as well as interdisciplinary topics which apply to most subjects in Norwegian schools. When we create teaching material, we chose relevant competence aims and translate these into learning goals. In the information to teachers, we emphasize which curriculum and competence aims the teaching material is representing. When it comes to topics, the results from the last user survey indicate that teachers and students are interested in a wide range of the broad topic categories we produce statistics and analyses about on ssb.no, where some are more prominent than others (see Figure 2).

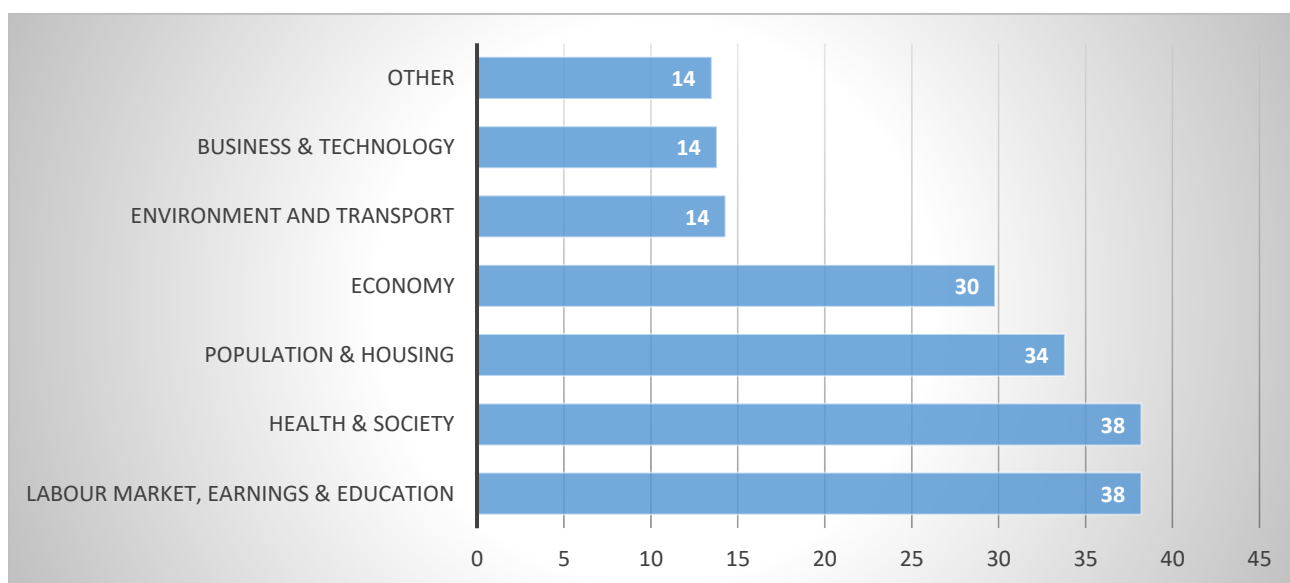


Figure 2. Topics of interest on ssb.no. Students and teachers. Per cent

So far, we have concentrated our efforts by providing relevant material for social studies and two of the interdisciplinary topics ‘democracy and citizenship’ and ‘sustainable development’. The pedagogic theory emphasizes varied tuition and active students’ participation in solving different exercises individually, in smaller groups or in a plenary class setting. We use films, quizzes, text, tables, figures, the Statbank and visual graphics, and at various competence levels to provide differentiated teaching material for the typical school class. We also ask the classes to carry out meta learning activities, to reflect actively on what they have learned and

to clarify outstanding questions. We aim at introducing students to facts and figures. Another learning outcome we aim at in these courses is to give the students training in finding reliable sources about elections and apply digital tools in their work. One of the learning goals was to introduce students to the most central concepts, reduction goals and facts about national and global greenhouse gas emissions, and to give them a glance into international climate change negotiations. In the booklet and the different exercises, students are introduced to national and international official statistics, and to short political texts about the politics of climate change. Again, the exercises are varied, and a word bank for learning central words about the topic is part of the exercises.

Further, we aim at providing teaching material, which is also relevant in current discussions in society, and amongst the young generation. If the teachers find that the teaching material is of interest to the students in their daily lives or relevant for discussions, we are likely to be on track in providing the schools with relevant and interesting material which will advance the students' literacy within the use of official statistics.

The last released teaching material is one which was requested at the focus meeting we had with a group of teachers in January 2022, i.e., economics and more specifically about the general budget equation and national accounts. Here, the students are introduced to central macroeconomic concepts, are challenged to define concepts in their own words, find figures for the general budget equation and analyse changes in the economy for various years, including the pandemic years, and to find and analyse figures about Norway's external trade in goods and services.

A draft of teaching material on survey methods was presented for a group of teachers in January 2022. The headline of the material was: "How and who are we going to ask about what?". This material includes three parts: 1) sample and sampling methods, 2) data collection methods and 3) definition of validity and operationalization. Among the feedback we received were: 1) the material is useful and covers knowledge that gives students the possibility to understand how to produce statistics of good quality and how to start conducting small surveys; 2) the material needs to be differentiated according to several levels of mathematical

competence and technical skills; 3) to use students-friendly datasets and populations as much as possible.

To make this teaching material user-friendly, we decided to start a pilot project with one of the schools (see paragraph 6). The pilot project involves several visits and meetings with students and teachers from this school, presentation of the teaching material, observation of the learning process and collecting of feedbacks.

In addition to working with teachers and schools, we are collaborating with NDLA (Norwegian digital learning arena)⁶ about offering learning resources for use in secondary school education. We have delivered some adopted datasets, desirably from “real life” for teaching in statistics (students-friendly datasets that can be used to calculate descriptive statistics and different measures of central tendency and spread).

5. Educational activities outside of the school

To reach an audience both broadly and deeply a usual strategy is the so-called “double-sided strategy”. An indirect approach (broadly) is the most effective to cover a larger audience or target group with less efforts. A direct approach (deeply) is more suitable to get valuable and detailed feedbacks and collect information about more individual needs and wishes. However, this way is very time-consuming and can rarely be prioritized. SSB school has been testing both approaches for different tuition materials.

Prior to the Covid pandemic, Statistics Norway arranged some courses for school classes on premises⁷. Now this activity continues in a smaller scale because SSB school doesn't have capacity to continue to use the direct way in a large scale.

Statistics Norway has been continuously developing content for social media where simple infographics, videos and sometimes humor are used to present Statistics Norway and to strengthen both our reputation and the awareness of the existence of Statistics Norway.

⁶ www.ndla.no

⁷ It was around 20 classes visiting us each year before.

6. A pilot project

Building on experience from and following the examples of assignments in the European Statistics Competition in 2021/2022 we have developed and started testing teaching material in survey methods with creative assignments based on surveys being conducted in Statistics Norway.

In May 2022, upon request of a teacher, we conducted a 2-day workshop with students and their teacher as a pilot project to test developed teaching material in survey methods where students and teachers were engaged in education activity. It concerned the program subject “Sociology and socio-anthropology”. One of the competence aims in this subject is that “students shall evaluate social science theories, methods and ways of thinking, and use these to explore social and cultural phenomena and conduct social science survey”. The teacher proposed a set of questions that the class wanted the material to cover. Based on this, we adopted the material to teacher’s suggestions. It is worth noticing that the students had already conducted small surveys of different themes on the school population. So, they had some valuable experience to build on. At the workshop the developed teaching material was used, different statistical definitions were presented, various practical assignments were done in Statbank and Excel, a fun and interesting experiment was carried out, and students’ feedbacks were collected after each day of the workshop. A Kahoot quiz (with more than 20 questions) was used to see how much information students remembered after the first intensive study day. The first day was dedicated to research methods in general and to sample surveys as one of the most used quantitative research methods. The second day was dedicated to a survey sampling case. The focus was on bias and representativity of a sample. The students reflected very actively around these problems and were involved and excited about practical exercises and an experiment. Among the feedback we received were:

1) the material was informative and useful, and presented in both serious and entertaining way,

2) it became clearer for students how to produce statistics of a good quality and how to start conducting small surveys,

3) useful practical examples in Statbank and especially exploratory practical experiment with liquorice balls where students learned about stratified sample in an enjoyable way (see picture 1).

Praktisk oppgave «Sweet dreams»



Picture 1. Experiment's material used for a practical exercise during the two-day workshop in Nydalen high school.

Among recommendations we get were:

1) to divide the information into smaller volumes and to have more workshop days,

2) some definitions, difficult words⁸ are unknown and difficult for students to understand. It may be an option to use adopted definitions in the beginning and explain definitions gradually through examples,

3) to use mathematical formulas and mathematical symbols in a small scale or not at all and to give this part of teaching material to math teachers which can incorporate the math part into the math lessons when they teach statistics.

This pilot was a valuable experience for SSB school. We have collected useful insights and recommendations for further development of the teaching material. To

⁸ For example, the word «empirical» and others.

summarize, building the material around real-life examples, adapted to the students' prior knowledge, is essential.

7. Conclusion and the way forward

Broadening the contact we already have with teachers, combined with knowledge of school curricula, teaching methods, pedagogy, and the results from pilot projects, will hopefully keep us on a good path in providing teachers with relevant teaching material. To make our statistics and knowledge about its production available and useful for students is the first step to increasing statistical literacy among young people in Norway. We need to use our resources efficiently by creating interesting and usable teaching content for ssb.no and by offering courses to teachers at conferences and professional meetings. To continue having school visits is not our ambition, but there may be useful and rewarding exceptions.

It is important to take into consideration the differences in student motivation, learning preferences and different levels of knowledge. Some students need very adapted information, some need challenges. That's why we try to differentiate and have pedagogical focus in our products.

We will keep on working to release teaching resources on other topics, hopefully in close contact with our main user group - teachers. It is always challenging to assess what is the most relevant material to produce and spend our resources on.

In developing SSB school further, we should take inspiration from international developments within youngsters' social media use and other information channels⁹.

Also, our established user contact, following the developments of the curricula, as well as pedagogic principles of varied and differentiated tuition, provide good guidelines for our work on improving statistical literacy.

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