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# Teaching statistics in Hungarian schools: situation analysis and development opportunities

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*In Hungary, teaching of statistics has been part of the curriculum for only 20 years. The introduction has been gradual: while the earlier curricula aimed at a low level of statistical literacy, the recent curricular changes have moved to a higher level. Despite initial difficulties, the subject is now popular with students and teachers alike. To maintain this, it is important that teachers are given adequate support to teach statistics at a higher level. In this article, we describe the development and current situation of teaching statistics in Hungary, and the research and development activities that have been taking place in this field. We examine whether teachers' attitudes, skills and interest in statistics (education) are congruent with the development of the statistics curriculum in Hungarian schools.*

*Keywords: Statistic education, curriculum development, teacher attitudes.*

## **Introduction, theoretical framework**

There is a wide range of international literature on the development and teaching statistical literacy. Developing statistical literacy is an important task for schools in our data-driven everyday lives (Watson, 2003a). Secondary schools play an important role and offer many opportunities in this process (Watson, 2003b). Over the last 20 years, there has been a growing demand for education to focus more on statistical literacy, reasoning and thinking (Ben-Zvi & Garfield, 2004). However, it is not unique that statistics education is nevertheless often simply a matter of learning and practising definitions and new procedures, without the need for a deeper understanding of the underlying concept (Batanero & Borovcnik, 2016). The term statistical literacy increasingly carries the connotation that an individual can be goal-oriented in a specific field, rather than simply acquiring basic knowledge (Gal, 2002). In recent years, the critical handling and interpretation of data has also become emphasised in terms of growing up and taking responsibility (Schiller & Engel, 2018). Another important task related to this topic is designing curricula around statistics and the targeted organisation of classroom procedures (Ridgeway, 2015). Examining teachers' skills and attitudes towards teaching statistics in primary level (Chick & Pierce, 2008) and secondary level is a crucial phenomenon for development.

In Hungary, statistics was introduced as a separate subject in secondary education in the 1950s, but only in vocational schools (Tóth, 2006). In secondary grammar schools, the subject of statistics did not appear in the final exam requirements before 2000. However, in the last 20 years, there have been many changes in this field in Hungary. In this essay we present a brief history of the topic, the current situation and possible directions for further development. First, we would like to demonstrate the changes in the curriculum, then we analyse the requirements of school-leaving examination, and

finally introduce the results of a teacher survey. In this way, we aim to provide a complex picture of the circumstances of statistics education in Hungary today.

As for the possible way forward, several doctoral research projects have currently been dealing with the teaching of statistics in Hungary, and this is one of the main elements of a four-year research project launched by the Hungarian Academy of Sciences in September 2021. As an essential element of the thorough investigation of sources conducted by the authors of this article, a system for defining levels of statistical literacy has also been developed. The system defines 3 levels, grouped according to statistical content (measures of central tendency and variability, charts). The first level is characterised by the application of basic conceptual knowledge and the ability to perform simple calculations. The second level is characterised by the skill to solve more complex, multi-step tasks, and to compare and contrast them. The third level is characterised by reasoning, argumentation, generalisation and abstraction. Considering that the incorporation of elements of statistical literacy is still at an early stage, 3 levels are sufficient to describe the characteristics currently want to be observed.

## **Development of teaching statistics in Hungary since 2000**

In order to understand the changes in teaching statistics, we will examine different segments of education: the official curricula, the requirements and tasks of the final examination (which have a greater impact on the content of education than the curriculum itself).

### **Curricula**

In Hungarian public education, teaching statistics was not included in the requirements at all in the 20th century. The first time when statistical knowledge appeared within mathematics was in the framework curricula of the National Curriculum, which were prepared in 1995 and came into force in 2000<sup>1</sup>. Since then, the National Curriculum and the framework curricula have undergone several major and minor changes (one major change in 2012, the other in 2020). The 2000 (Sajtóiroda, 2004) and 2012 framework curricula (Oktatási Hivatal, n.d.) had very similar requirements within the subject of statistics. In grades 1–4, the requirements included collecting data, making tables and graphs, reading and interpreting them; interpreting the arithmetic mean of some numbers, introducing the concept of "average", using it to characterise sets of data. In grades 5–8, the pie chart, the mode, the median and the analysis of data sets were also introduced. In addition, in grades 9–12, the ability to measure the standard deviation of data, to know the sampling with or without replacement and to solve problems related to them.

The 2020 framework (Oktatási Hivatal, n.d.) has introduced significant changes in several aspects, mainly in the requirements for secondary schools. In grades 9–10, the interpretation and evaluation

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<sup>1</sup> In Hungary, since 2000, the content of teaching and learning in schools has been determined by a three-tier curriculum regulation, as prescribed by law. The top level of regulation is the National Core Curriculum. The second level of content regulation is the framework curricula, which provide both curricular and methodological support. The third, local, level of regulation is the pedagogical programme of the schools and the local curriculum drawn up by the teachers in the schools.

of data, the drawing of simple statistical conclusions, the choice of the appropriate type of graph to represent a specific set of data and to answer a statistical question, the creation and reversal of a pie chart into a bar chart, the recognition and correction of graphical manipulations in graphs are new items. Also new materials in grades 11–12: visualisation of the concept of a representative sample; classification and characterisation of statistical data using quartiles, means and scatter; construction and use of box-plot diagrams; interpretation and evaluation of data, statistical inference; recognition of statistical manipulations in graphics and text.

In addition to the changes in content, another important difference is that the 2020 framework proposes significantly more time (more than 50% more than in the 2012 curriculum) for teaching probability and statistics.

### **Requirements and tasks of the final exam**

One of the characteristics of Hungarian mathematics education is that classroom practice is influenced more by the requirements and tasks of the final exams than by the curriculum itself. In Hungary, a new final exam<sup>2</sup> system was introduced in 2005 (Csapodi, 2016). The requirements for the intermediate level exam were determined by the content of the National Core Curriculum and the basic curriculum, while the requirements for the advanced level exam were more in line with the needs of higher education. Changes in the curriculum are of course always followed by changes in the requirements for the final examination. Knowing that the secondary school curriculum devotes 9% of the available time to probability and statistics, it is interesting to see that the examination requirements of these topics in the examination papers for the baccalaureate are 15%, which is much closer to the 12% timeframe in the new curriculum.

The current requirements for the exam are generally quite simple, falling into level 1 mentioned in the introduction: the ability to draw pie charts and bar graphs and to read data from them; to calculate mean, mode, median and standard deviation. The only requirement that goes perhaps a little beyond these is to be able to compare data sets using the statistical indicators learned.

Due to the changes in the curriculum in 2020 and the increase in the time available for teaching statistics, the requirements for the baccalaureate will also change from 2024. In addition to the previous requirements, the concept of quartiles and box-plot diagrams will be introduced, but more importantly, the requirements include the ability to choose the appropriate diagram for the situation and to argue for the choice, and at advanced level the ability to choose a mean value that well characterises the data set, to argue for the choice, and to evaluate and analyse the statistical indicators obtained and to draw statistical conclusions. These are a very big changes from the more traditional closed-ended tasks in Hungary.

Looking at the sets of tasks over the last 15 years, we see that the tasks on statistics do not go beyond level 1 of statistical literacy (the level system mentioned in point 1), as required: making simple diagrams, reading data from diagrams, calculating means and dispersion coefficients. The evaluation

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<sup>2</sup> By *final exam* we mean an exam that is to be performed by those who leave secondary school at the age of 16 or 18, before entering higher education. This type of exam is also called *matura*, *baccalauréat* or *graduation exam*.

of the results obtained, and the analysis of the data have not been included in the questions so far. In the 50 or so sets of intermediate level questions that have been used since the introduction of the new examination system, there are few that require more complex thinking.

Research on the detailed analysis of final exams (Csapodi, 2016; Csapodi & Koncz, 2016) show that students at both levels are successful in solving statistics problems and, where there is an opportunity, they are willing to choose the corresponding problems<sup>3</sup>. Knowing that statistics is a relatively new subject in schools, there are two possible explanations for this. It is possible that the statistical literacy of teachers (see the results of the teacher survey later) and the available teaching materials have improved as well. On the other hand, we have also seen that, out of understandable caution, the requirements for these subjects only ask candidates to demonstrate basic knowledge. One of the consequences of this is that the examination requirements for these subjects from 2024 onwards will require a greater amount of knowledge and more complex competences from candidates than in the past, albeit to a lesser extent.

RQ 1. Whether or not teachers' attitudes, skills, and interest in statistics (education) are congruent with the development in the curriculum of statistics at Hungarian schools?

RQ 2. What is the attitude of Hungarian math teachers to further expansion of the statistical curriculum?

## **Methodology**

### **Designing the teacher questionnaire survey**

In connection with the current changes, we have conducted a survey for research purposes, involving secondary school teachers. As a research method, a questionnaire survey was chosen due to the uncertainties of the epidemic situation. This quantitative research method is easy to conduct online, and the results can also be evaluated in this form. The aim of the survey was to obtain information on the studies, attitudes, and classroom habits of teachers in the field of teaching descriptive statistics. Taking these details into consideration, further education and development opportunities should become more targeted, both in terms of teacher education and teacher training.

The questionnaire consisted of four main parts: background data on the respondents; rating of statements on a 5-point Likert scale in 2 groups of questions: (1) How much do they agree with the given statements about the teaching of statistics? (2) To what extent do they feel that the given statements about the teaching of statistics are true for them? The fourth part of the questionnaire measured the popularity of teaching particular mathematics areas. A total of 28 statements were assessed in parts 2 and 3. The main statements: 7 + 6 + 7 statements were included for basic attitudes, assessment of students' knowledge, and framework knowledge. The sub-statements: 3 + 3 + 2 statements are listed in order of opinion on the working methods used, about the assessment and the current requirements. The questionnaire was tested on a small sample, using convenience sampling.

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<sup>3</sup> It is not necessary to solve all the problems in the exam to get the maximum score, both at intermediate and at advanced level students can skip one of the exercises.

## Results of a teacher survey

The questionnaire for an online survey was completed by 181 teachers. Although the survey is not representative, we can say in terms of background data, that the composition of the respondents is similar in terms of both settlement type and school type to the proportions measurable in the society of Hungarian teachers. As far as professional background is concerned, more than 80% of respondents have been teaching at secondary grammar schools for more than 15 years. Nearly 30% indicated their own secondary school studies as the source of their knowledge needed to teach statistics, 56% chose their own university studies, 76% chose 'their own teaching experience', and almost 60% mentioned their 'own research'. The following table summarizes the proportion of groups with different professional experience in details (measured in years) that indicated their own secondary education as a source, their university studies and their teaching experience gained during their work. (Several sources could be marked, not just their main one.)

**Table 1: Distribution of teachers by teaching experience and source of statistical knowledge**

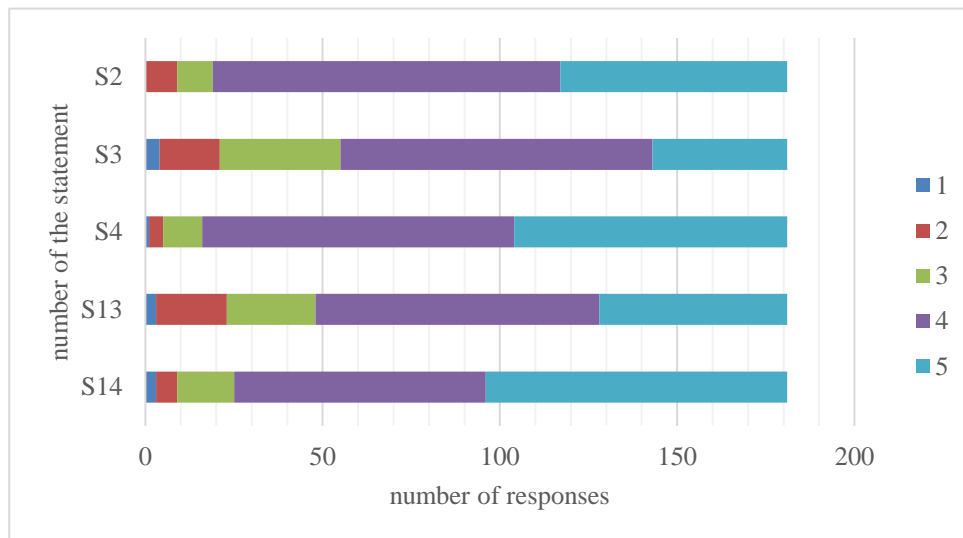
Years in public education	Number of teachers	Secondary school studies	University studies	Teaching experience
More than 25 years	65	8 (12%)	38 (59%)	58 (89%)
15–24 years	78	12 (15%)	38 (49%)	61 (78%)
5–14 years	24	13 (54%)	15 (63%)	18 (75%)
Less than 5 years	14	14 (100%)	11 (79%)	8 (57%)

Given the detailed data, just a small proportion of teachers who have been teaching for more than 15 years have high school statistical studies and also in these age groups there is the lowest indication of university statistical qualification. In the case of those, who have been teaching less than 15 years, the presence of high school statistics education can be well traced. The teaching experience is also expected to decrease as the number of teaching years decreases.

During the examination of the sources used to teach statistics, we found that, that 78% of respondents use the available textbooks and 91% use available exercise books and 92% work with statistical tasks in the graduation task series of previous years. Thus, we can say that the need for purposeful preparation for output requirements is very strong, and that it is substantial to examine the available textbooks and exercise books when inspecting the teaching of statistics thoroughly.

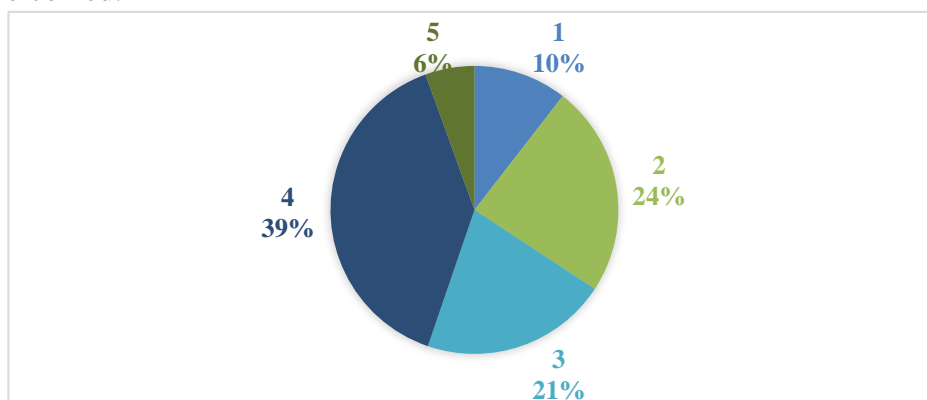
Based on the evaluation of the 12 statements of the second part, we can say that the majority of teachers (60%) fully or largely agree that the students' knowledge meets the current requirements, their fulfilment does not mean any difficulties. The statistical questions of the final leaving exam are not considered difficult, however, they do not support raising the level of questions, as well as raising the number of lessons devoted to the topic and expanding the curriculum in this field. On the other hand, there is a great deal of interest and willingness to participate in in-service teacher training on statistics (74.6%).

The 16 statements in the third part included, for example, statements about the framework curriculum. It was found that only 50% of the respondents stated that they were aware of the changes in the framework curriculum, on the other hand, as a result of all this, there is a very high degree of indifference – more than 57% – to the changes in the framework curriculum. The feedback on classroom habits is more varied. The new elements – reasoning, data evaluation (S2, S3), analysis (S13, S14), statistical conclusions (S4) – were not welcomed, although, according to the answers, the graph shows that the new methodological expectations have become part of the teachers' daily work.



**Figure 1: Grading statements about the appearance of interpretation and evaluation in teachers' own classroom work**

In written school exercises and tests, open items that require justification or reasoning are not used and are not welcomed.



**Figure 2: Integrating analysis and evaluation into tests with statistical content**

In the fourth, concluding part of the questionnaire, the respondents rated how willing they were to teach certain areas of mathematics. (1 = very much dislikes, 2 = dislikes, 3 = indifferent, 4 = likes, 5 = very much likes). According to this ranking, it seems that the classical topics with a long tradition (equations, algebra, sets, functions, etc.) are the most popular whereas, for example, logic and probability only achieved lower scores, statistics and graphs were in the lower midfield.

## Conclusion

Based on the responses to the 28 statements in the questionnaire, we can therefore say that teachers are generally satisfied with the current statistical requirements, the number of the proposed lessons and the achievement of their students (RQ1). However, the direction of stepping forward is less popular, both in terms of increasing the number of lessons in the field, expanding the content, and changes in final exam requirements (RQ2). Preparation for the exam requirements is still highly emphasised. To change the basic approach, it is necessary to incorporate new expectations and methodological issues in both teacher education and teacher training in statistics education; and to support colleagues' work by creating a novel, free-to-use task collection.

## Summary and outlook

Regarding to the situation of descriptive statistics education in Hungary, based on the above, we can state that many positive changes have taken place in this field since 2000: basic knowledge of statistics has been included in the curriculum and among the final exam requirements; based on the research, statistics have become a popular topic for students, they successfully solve these types of tasks, for example on the final exam; the proportion of this topic has increased during the latest curriculum developments; there has been a shift in the curriculum and in the graduation requirements from the simple return of conceptual knowledge towards application, interpretation and analysis; basically teachers like teaching descriptive statistics. At the same time, it is evident in addition to positive changes, that there are areas where further development may be substantial: it is worthwhile (in line with international practice) to add additional elements to the statistical part of the mathematics curriculum, for example, the possibility of regression and correlation calculation, as well as the possibility of hypothesis testing in the curriculum should be examined; the statistical part of textbooks and exercise books should be expanded and enriched, the authors of this article play an active role in this work; to deepen the knowledge of teachers, to help their methodological preparation, to consider important to expand statistical knowledge, to prefer to deal with the teaching of statistics.

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