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**COMPARATIVE ANALYSIS OF STATISTICS TOPICS
TAUGHT IN KAZAKHSTAN IN GRADES 6–8**

The Republic of Kazakhstan pays special attention to the quality of education in order to keep up with the number of developed countries, as a result of which the school curriculum is undergoing various changes, and the haphazard nature of Statistics topics found in Mathematics textbooks makes it difficult for children to understand statistics and probability theory. Elements of statistics are an important branch of science used in many fields. Therefore, in the age of information, it is very important for students to be able to understand the elements of Statistics and work with data. In this article, we identified the advantages and disadvantages of some systems taught in our country by conducting an analysis of the topics of Statistics and the assignment of tasks that are found in textbooks of grades 6–8. The results of the analysis will be useful in bringing the topics of Statistics to a certain system.

Keywords: statistics elements, teaching statistics, probability theory, Cambridge program, education in mathematics.

Introduction

The rapid development of probability theory and mathematical statistics in the XIX–XX centuries, the constant expansion of the scope of their application, as well as changes in the scientific picture of the world caused by this process led to the question of including components of these sections of mathematics in the content of secondary school education. Students' ability to understand statistics is often directly related to the teaching of statistics in the school curriculum. In Kazakhstani secondary state program, elements of probability theory and statistics

are included in the subject of mathematics. The support provided by textbooks and curricular materials for elementary and secondary school instructors is insufficient. As a result of research, statistics and mathematics must be studied at all levels of education. Statistical reasoning is distinct from mathematical reasoning starting from elementary schools at the lowest level to higher [1]. Students must view mathematics and statistics in the proper perspective and be able to discern between distinct aspects of their logic. Some issues to the curriculum are that students who complete the course often happen to be not have chosen and discussed the content of the course; and they view it as a set of formulas and procedure that are often considered as the set of numerical expressions. Most of the suggestions for improving and reforming the first year of statistics center are on the use of technology, the incorporation of the real data, and the use of active learning approaches to engage students. When it comes to determining the relevant formula and doing the computation, real data may be utilized to focus on statistical principles and methods rather than the typical theoretical approach [2]. To improve efficiency of learning statistics, it is important that learning objectives are clearly defined from the content and methodology is addressed accordingly.

A similar consensus exists on the idea that teaching statistics should emphasize understanding of statistical ideas and procedures, as well as encouraging students to recognize the need of being able to analyze the massive amount of statistical data they face every day. Achieving these goals is only possible if students are challenged in their learning experience to solve specific problems based on real-life situations. Students in high school who took modules that included laboratory lessons had a high level of knowledge and abilities [3]. At the same time, the few numbers of real-life problems and the inconsistency of topics in a mathematics textbook at each class level make it difficult for students to understand topics in statistics course. Traditional techniques, especially when teaching introductory statistics courses, are typically considered as ineffective, according to the researchers, and contribute to students becoming concerned about their tasks since they perceive statistics to be a difficult field [4]. As a solution, in our future research, we will conduct in-depth research on teaching elements of statistics based on interdisciplinary communication. Interdisciplinary link is one of the specific forms of the general methodological principle of regularity, which defines a special type of mental activity-system thinking [5].

The statistics need to work with inductive-probabilistic way of thinking. Furthermore, statistics is a branch of mathematics; nonetheless, statistics does require mathematics. However, statistics has the different way of thinking and tools, nowadays, we can realize that statistics is a separate discipline which need a math calculation. The distinction between mathematical and statistical

thinking have become more apparent because of statistical education research [6]. The importance that data collection, representation, and processing have gained in modern society, and because of the growing use of statistical methods in forecasting, there is now widespread agreement in the international scientific community that statistics teaching should be given more attention. Statistics and data science are becoming more rigorous in learning how to recognize and apply tools that are fast developing in their projected vocations as the demand for qualified, university-level data scientists develops. The school curriculum of Kazakhstan is undergoing various changes, and the unsystematic nature of statistical topics found in Mathematics textbooks makes it difficult for children to understand the elements of Statistics and probability theory. By analyzing the transmission of statistical topics in different systems, you can determine the advantages and disadvantages of topics in our program. For the main purpose of this article, the analysis of various systems will be carried out primarily to systematize the topics.

Materials and methods

In the process of education in different systems, the main source of information is textbooks taught under the program. For the analysis, mathematics textbooks were selected, which is taught in grades 6–11 of three different programs (Public schools, Cambridge system, Bilim-Innovation Foundation (BIL schools) programs). In our analysis, the statistical topics in Mathematics textbooks of these programs will be compared.

Table 1 – Analysis of the topic «elements of Statistics» in programs of grades 6–8 in various educational systems in Kazakhstan

Grade	Public-school program	B I L (B i l i m - innovation lyceum)	Cambridge CIE (international school)
6	Statistical data and their characteristics. Averages (mean, mode, median)		Planning and collecting data, planning to collect data, collecting data, using frequency table
6	Problems for finding averages of speed. Combinations: tree diagrams		Averages, average and range, the mean, comparing distributions
6			Probability, the probability scale, equally likely outcomes, mutually exclusive outcomes, estimating probabilities

6			Interpreting and discussing results Interpreting and drawing pictograms, bar charts, bar-line graphs and frequency diagrams Interpreting and drawing pie charts Drawing conclusions
7	Variation series	Variation series. Frequency. Graphs Basic concepts of statistics	Planning and collecting data, collecting data, types of data, using frequency table
7	Absolute and relative frequency	Relative and absolute frequency.	Processing and presenting data, calculating statistics from data, calculating statistics from grouped or continuous data, using statistics to compare two distributions
7	Frequency polygons	Presenting data Histograms Line graphs Pie charts	Interpreting and discussing results, frequency diagrams, pie charts, line graphs, stem and leaf diagrams, drawing conclusions
7			Probability, the probability that an outcome does not happen, equally likely outcomes, listing all possible outcomes, experimental, theoretical probabilities
8	Histograms. Table of intervals.	Histograms of frequencies. Frequency polygons.	Planning and collecting data, identifying data, types of data, designing data-collection sheets, collecting data
8	Cumulative frequencies	Average value. Variance. Standard deviation	Processing and presenting data, calculating statistics Using statistics
8	Average value. Standard deviation and variance		Interpreting and discussing results, frequency diagrams, line graphs, scatter graphs, stem-and-leaf diagrams, comparing distributions and drawing conclusions
8			Probability, calculating probabilities, sample space diagrams, using relative frequency

Results and discussion

6th grade: Two topics are given in the statistics section of the textbook written by [7] which is taught in the public schools of the Republic of Kazakhstan. The topic provides a definition of each statistical term and related examples and tasks.

Topics on data processing are given by explanation and examples in the Cambridge CIE textbook [8]. It explains data collection, processing, and displaying results. According to the program, students get acquainted with probabilities and central tendency. Both programs cover the topics of the central tendency for the 6th grade. The main difference between textbooks is the presentation of problems on this topic. First, according to the Public Program, mostly random numerical problems were given, and there are few problems that provide information about the given numbers, and according to the Cambridge Program, each given number is presented according to the preliminary information. Secondly, the Cambridge program presents various problems to find central tendency, so that students can learn how to analyze them by differentiation. On the contrary, most of the Public Schools Program's books consist of homogeneous problems, that is, providing only mathematical calculations. The main peculiarity of the Cambridge program is the topics for working with data. The textbook primarily shows the types of data, how to collect it, and how to represent the collected data using tables, charts, and graphs. This can greatly help in improving the statistical literacy of students. Another topic that is not mentioned in the state program is probability. The Cambridge program shows the simplest probability topics, respectively, which are considered at the easiest level in calculations. The main difference shown in the state program is the solution of problems using the average value of movement and tree diagrams. However, we can see that the topics are not related.

7th grade: The mathematical textbook of the state program for the 7th grade contains three topics of Statistics, the books of the BIL program-three, and the Cambridge program-four. According to the general analysis, the topics of the BIL and the state programs largely coincide with each other. It is only in the presentation of data that the state program provides only frequency polygons, and in the textbook of the BIL it shows other types. However, there are significant differences in the presentation of problems in the program. Problems with numbers for determining the variation series under the state program are given without information and examples are not specified in the textbook. Although the BIL textbook provides a definition of a variation series, the problems, and examples for it are not specified, the programs on other topics are presented fully [9]. In the problems for the frequency series of the state program, problems are not provided so that the student can independently create a frequency table, but information about the properties of the table and its use is given in the textbook. While the BIL program includes data representation using various graphs, linear graphs, and histograms, the state program is limited only to the frequency polygons. All

programs cover the topics of working with a frequency table and using frequency polygons for 7th class level. According to BIL and the state programs, the frequency table is represented only by discrete data, while the Cambridge program involves continuous data processing [10]. Since the Cambridge program has a spiral learning system, it coincides with the topics of the 6th grade. However, in the sixth grade, they get acquainted with data collection, in this class they learn its types and display it through a table, analyze it from a table. In terms of central tendency, grade 6 can only calculate from discrete data, and now there are topics for determining it from the frequency table and interval tables. On the topic of data representation in the Cambridge system, the topic of data representation that is not specified in the state and BIL programs, is the «stem and leaf diagrams». The main peculiarity of the Cambridge system is probability headers [11]. In this class, the topics of theoretical and experimental probability, probability of failure of an event are given. Most of the problems are word problems.

8th grade: During mutual comparison of the topic in the specified table, it was found that the curriculum of BIL and public schools completely coincide with each other. However, the data provided in some topics are different in programs. While the frequency polygon is given in the 7th grade in the public-school program, it is provided in the 8th grade in the BIL program. Information about the frequency density that should be used when drawing a histogram is not specified in the public-school textbook at all [12]. The implementation of the interval table by creating and using it begins in the 6th grade in the Cambridge program, in the 7th grade the students learn to create a histogram and calculate the central tendencies [13]. The biggest drawback of other two programs is that the interval table is shown only for creating the histogram in the 8th grade, and the problem is that the entire state of the interval table is not provided. However, the Cambridge program did not specify the topic of cumulative frequency for this class level, and the public-school curriculum was limited to finding this topic only through a table, while the BIL textbook supplemented it with a graph of cumulative frequency and a diagram. The definition of the cumulative frequency is indicated in the textbook, but the main objectives for its calculation and the procedure of calculation are not fully explained [14]. The topics of variance and standard deviation are considered by BIL and public schools program starting from the 8th grade, while in the Cambridge system, it is considered entirely in the subject of Statistics in 11th grade. In the Cambridge system, the topics of the 8th grade are directly related to the topics learned in the 6,7th grade. Using the knowledge of the past classes, 8th grade students learn to process data, analyze, and summarize it. The topic of the central tendency involves calculating it from the interval table and, accordingly, using the corresponding central tendency. The calculation of relative frequency on the

topic of probability is shown in the Cambridge and BIL textbooks; however, in public schools the topic is shown in the 7th grade, but problems for this topic is provided in the 8th grade. In the Cambridge program, the topics are supplemented with a both sided stem and leaf diagram, and a scatter diagram.

Conclusion

In conclusion, an analysis was made of the transfer of statistics elements in mathematics textbooks of grades 6-8. Since the BIL schools are subordinate to the state system, it was found that the topics covered in most classes coincide with the textbooks of the secondary school. However, differences were found in the questions and definitions presented with overlapping topics and the data they are supposed to interpret within that topic. The study of Cambridge textbooks showed that all topics are presented in a spiral system and become more complicated every year at the level of grades 6-10. On the other hand, one drawback is that these tasks are simplified for senior classes, but thanks to this system, students can fully master the main sections of statistics. As a result of the analysis of topics by comparing programs, we were able to identify the inherent advantages and disadvantages of each program. Now our goal is to systematize the topics in statistics, taking the necessary information from all programs.

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ҚАЗАҚСТАНДА ОҚЫТЫЛАТЫН 6–8 СЫНЫПТАРДАҒЫ СТАТИСТИКА ТАҚЫРЫПТАРЫНЫҢ МАЗМҰНЫНА САЛЫСТЫРМАЛЫ ТАЛДАУ

Қазақстан Республикасы дамыған елдер қатарына ілесе алуы үшін ең алдымен білім сапасына аса назар аудару кезеңінде, соның салдарынан мектеп бағдарламасы түрлі өзгеріске ұшырауда, және де математика оқулықтарында кездесетін статистика тақырыптарының жүйесіз сипаты статистика мен ықтималдылық теориясын түсінуін қиындатып отыр. Статистика элементтері көптеген салаларда қолданылатын маңызды ғылым саласы болып табылады. Сондықтан ақпарат заманында оқушылардың статистика элементтерін түсіне алуы және деректермен жұмыс жасауы өте маңызды. Осы мақаламызда елімізде оқытылатын кейбір жүйелердегі 6–8 сынып оқулықтарында кездесетін статистика тақырыптары мен тапсырмалардың берілуіне талдау жұмысын жасай отырып, артықшылықтар мен кемшіліктерді анықтадық. Талдау нәтижесі статистика тақырыптарын белгілі жүйеге келтіруде пайдасын тигізетін болады.

Кілтті сөздер: статистика элементтері, статистиканы оқыту, ықтималдылықтар теориясы, Кембридж бағдарламасы, математика саласындағы білім.

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СОПОСТАВИТЕЛЬНЫЙ АНАЛИЗ СОДЕРЖАНИЯ ТЕМ СТАТИСТИКИ, ПРЕПОДАВАЕМЫХ В 6–8 КЛАССАХ В КАЗАХСТАНЕ

Республика Казахстан уделяет особое внимание качеству образования, чтобы не отставать от ряда развитых стран. В результате чего, школьная программа претерпевает различные изменения, а бессистемный характер тем статистики, встречающихся в учебниках математики, затрудняет понимание детьми статистики и теории вероятностей. Элементы статистики являются важной отраслью науки, используемой во многих областях.

Поэтому в век цифровизации очень важно, чтобы студенты умели разбираться в элементах статистики и работать с данными. В этой статье мы выявили преимущества и недостатки некоторых систем, преподаваемых в нашей стране, проведя анализ тем и задания статистики, которые встречаются в учебниках 6–8 классов. Результаты анализа будут полезны для приведения тем статистики в определенную систему.

Ключевые слова: элементы статистики, обучение статистике, теория вероятностей, Кембриджская программа, образование в области математики.

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