AN ALGORITHM FOR ORGANIZING AND GROUPING DATA RELATED TO THE EXPENDITURESBY EDUCATION LEVELS

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Abstract

This paper presents an algorithm for organizing and grouping data related to the expenditures by education levels in Bulgaria. The built database is used as a source from which the necessary information is searched depending on the entered indicators and time interval.The considered indicators include the public and private expenditures by education levelsfor the period2012-2020.The extracted subsets of elements are processed and analyzed. In this connection, four groups of variables are calculated and discussed.The results show that the expenditures in four of the education levels (primaryand pre-primary education as well as upper and lower secondary education) grow over the last five years (2016-2020). The quoted indicator inpost-secondary, non-tertiary education isreduced gradually in 2016-2019. During 2015, as compared to 2014, the expenditures in the considered 7 levels of education decreased in the range from 0.29% to 7.81%.This work calculates the share of expenditure for tertiary education-bachelor, master and doctor in comparison with the totalexpendituresfor educationinthe indicatedtime period. The obtained value of the variable for this education level is the highest. It is 29.74%. The values of this variable are significantly lower for the following two levels of education - tertiary education-professional bachelor and post-secondary, non-tertiary education. They are 1.54% and 0.29% respectively.

*Key words***:** *algorithm, database, expenditures, education level*

INTRODUCTION

Modern information technologies have widely entered various spheres of our life [18], [12]. In this regard, the employees in the relevant companies and organizations must have the necessary professional qualification [1], [11], [16]. According to Angelov (2019) [4],"Education is considered an investment in human capital with long-run return horizon" [4]. Gergova (2020) [10] indicates that the sustainable development of an economy has a direct relationship with the level of development of education and science [10]. In addition, the study of Dragoeva (2022) [9] notes that "Increasing the spending on education is a prerequisite for a country's prosperity" [9].

The present work considers part of these exposed problems.Data from time seriesrelated to theexpenditure by education level, general schools by type,teaching staff in general schools, etc. are provided on the website of the National Statistical Institute of Bulgaria [13], [14]. They are saved in Excelfiles. The information from the listed sources is extracted and organised in a created relational database. Relational databases can be used to store data from various fields (economy, tourism, agriculture, etc.) [3], [8], [15].

Subsequently, these data are processed in order to obtain information that is used in making certain decisions from the relevant organizations [2], [5], [6]. The created database in this work contains the following table schemas:

- Country (id_n, name);
- Education level (ID, education level, id_n);
- Expenditures (ID, expenditure, year, id_d);
- General schools (ID, schools, id_c);
- Number_schools (ID, year, number, id_s);
- Teaching staff (id_1,years, number, id).

The Country table is related to the tablesGeneral schools and Education level.TheGeneral schoolstableis related to the following two tables - Number_schoolsand Teaching staff. The Education level table is related to theExpenditures table.The created relationships between the mentioned abovetables are of type one-to-many.

The aim of this paper is to present an algorithm for organizing and grouping data related to the public and private expenditures by education levels in Bulgaria. The built database is used as a source from which the necessary information is searched depending on the entered indicators and time interval.

MATERIALS AND METHODS

Description of the algorithm: The investigated objects are stored into individual tables in the mentioned relational database.Differentqueriescould be formed [7], [17] from the presented information from the database on the basis of pre-defined indicators.These indicators include the following components:
•expenditure by education level;
•number of the general schools by type;
•number of the teaching staff in general schools;
•time interval.
The scheme of the algorithm is presented in Fig. 1.The current workexaminesthe period from 2012 to2020. But userscould choose a smaller time intervalaswell as non-consecutive years from the indicated period.
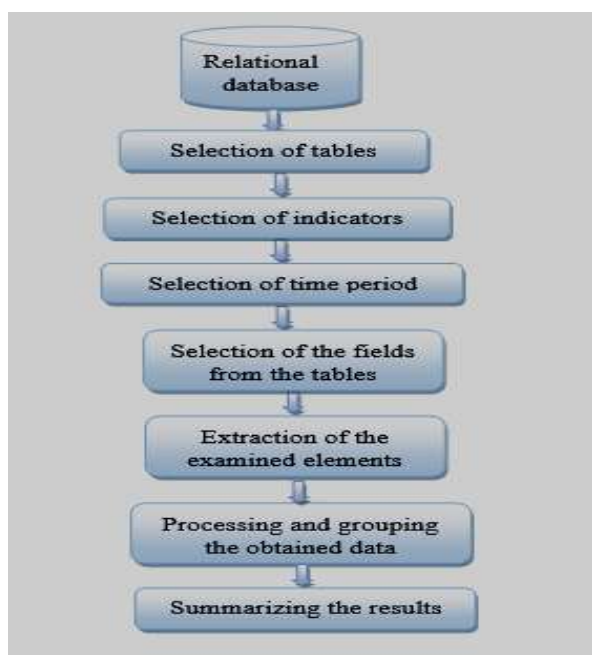

Fig.1. Scheme of the presented algorithm
Source: Own conception.

The tables containing the studied objects should be selected (Fig. 1). In this case, they are the following three tables:
•Country (id_n, name);
•Education level (ID, education level, id_n);
•Expenditures(ID, expenditure, year, id_d).
The consideredindicators include the public and privateexpendituresby education levelsin thementioned9-years time period.The choice of indicators determines the corresponding fields from the tables where the necessary data will be searched.
The extracted groups of elements are presented in separatequeries. Practically,the obtained information from these queries is processed and analyzed. In this regard, it is necessary to calculate the following four groups of variables in separate modules:

$$\bullet \ N_z = \sum_{k=1}^{b} w_{zk} \ \text{...} \ (1)$$

where:
b=9,
$z \in \overline{1;7}$;
N_z - the sum of the expendituresin the relevant level of education during the examined period.
In addition, it should be noted that thestudiedexpenditures are for the followingeducation levels:
-pre-primary education;
-primary education;
-lower secondary education;
-upper secondary education;
-post-secondary, non-tertiary education;
-tertiary education - professional bachelor;
-tertiary education -bachelor, master and doctor.

$$\bullet \ P_{zk} = w_{zk} \cdot \frac{100}{\sum_{i=1}^{7} w_{zi}} \ \text{................................} \ (2)$$

where:
P_{zk} - the share of expenditure for the relevanteducation level in comparison with the total expenditures for education during the considered year,
w_{zk} -expenditurefor a given level of education for k-[th]year, $k \in \overline{1;9}$.

$$\bullet\ C_z = \frac{N_z.100}{\sum_{k=1}^{7} N_k} \quad\text{.......................................(3)}$$

where:

C_z - the share of expenditure for the given level of education in comparison with the total expenditures for education for the studied time interval, $z \in \overline{1;7}$;

$$\bullet\ F_z = \frac{w_{z9}}{w_{z1}} \quad\text{...(4)}$$

where:

w_{z1} and w_{z9} -expenditurefor relevant level of education for the first and the last year from the investigated time period.

This workalso summarizesand discussesthepresented results.The obtained conclusions for each one of the considered indicators during the examined period are visualized.

RESULTS AND DISCUSSIONS

The choice of tables from the built database is determined depending on the examined information.The considered objects in this study are searched from the related tables Country, Education level and Expenditures.The values of the studied indicators are extracted from several fields from the listed tables.These are the relevant expenditures in the abovementioned education levels.

The extracted elements from the database are analyzed in the time segment 2012-2020.In this connection, the dynamics of changes in each of the expenditures in the relevant level of education are discussed.The linesin Fig. 2 presentthe values of theexpenditures inpost-secondary, non-tertiary education and tertiary education - professional bachelor(shown on the secondary vertical axis), whereas thecolumns present the expenditures for the rest five levels ofeducation(shown on the primary vertical axis). On the whole, the expenditures in 6 of the considered education levels grew rapidly in the years between 2013 and 2014.Onlytheexpenditures in post-secondary, non-tertiary educationare reduced in 2014.During 2015, as compared to 2014, the expenditures in the listed 7 levels of education decreased in the range from 0.29% to 7.81%.

More different situation is observed in theperiod 2016-2020.The expenditures in four of the considered levels of education grew. These levels include upper secondary education, primary education, lower secondary education as well as pre-primary education. In addition, the examined variable in the four-year time segment (2016-2019) for post-secondary, non-tertiary education isreduced. A decline in the indicated expenditures in tertiary education-professional bachelor is presented for 2016 and 2018. This indicator in tertiary education-bachelor, master and doctor reducedin 2017 (Fig. 2).The lowest values for the examined expenditures(w_{z1})in 6 of the considered educationlevelsare registered during 2012. While the expenditures ($w_{z9)}$ in each of the mentioned 6 levels of education are the highest in 2020.

The obtained values of the variable (F_z)vary in the range from2.03 to 1.54.In this case, theexpendituresin primary education are increased more than 2 times during the 9-years time period. A similar result is obtained for theexpenditures in lower secondary education, upper secondary education and tertiary education-bachelor, master and doctor, where the growth of the studied indicator is more than 1.9, 1.8 and 1.7 times respectively, in the indicated period.

The expenditures for tertiary education-professional bachelor and pre-primary education are also increased by more than 1.6 and 1.5 times.An exception is also established. Only the expenditures for post-secondary, non-tertiary educationat the end of the time segment decrease compared to the first year from the consideredinterval (Fig. 2).

In addition, it should be noted that, during 2020 as compared to 2019, the expendituresin the studied education levels are greater. In this case, this is the period when the COVID-19 crisis occurred.

The present work analyzes the results concerning the calculated sum of the expenditures (N_z) for each of the listed education levels in the 9-years interval.
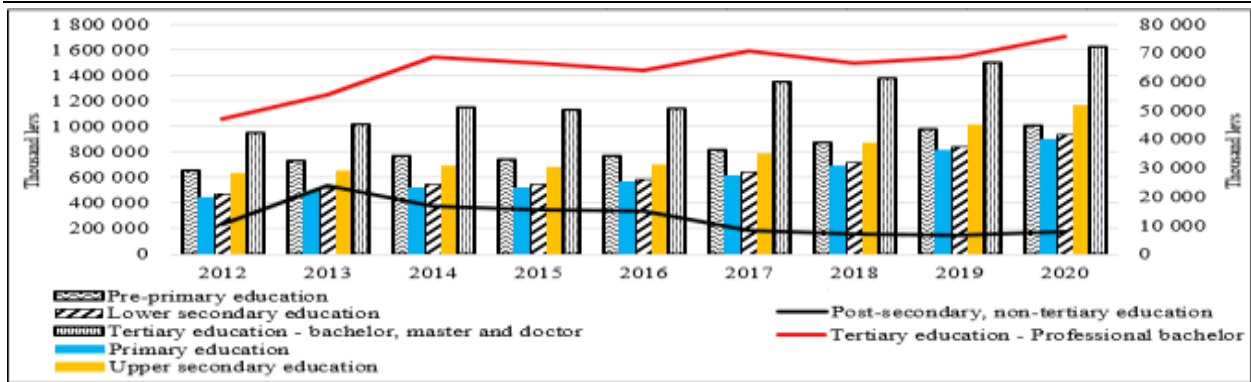
Fig. 2. Dynamics of changes in the relevant expenditures in the considered education levels for the period 2012-2020
Source: Data fromthe National Statistical Institute [13, 14].

The values of this indicator for tertiary education - bachelor, master and doctor are significantly higher, as can be seen from Fig. 3.

High values of the indicator are also obtained for 4 of the considered levels of education (lower and upper secondary education, primary educationas well as pre-primaryeducation). The total expenditures in two education levels (post-secondary, non-tertiary education and tertiary education-professional bachelor) are the lowest in the studied period.

Theresults for the variable P_{zk} are visualizedin the diagram in Fig. 4.
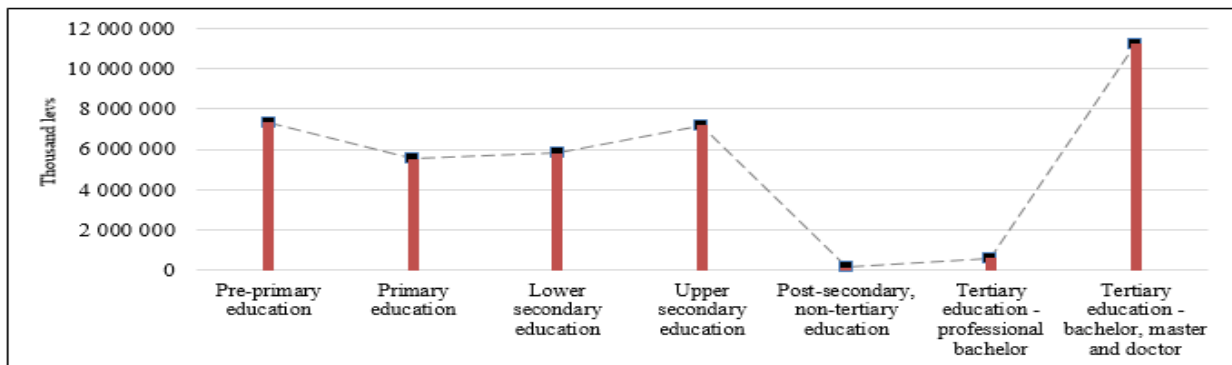

Fig. 3. Results concerning the calculated sum of the expenditures in each level of education during the examined time period.
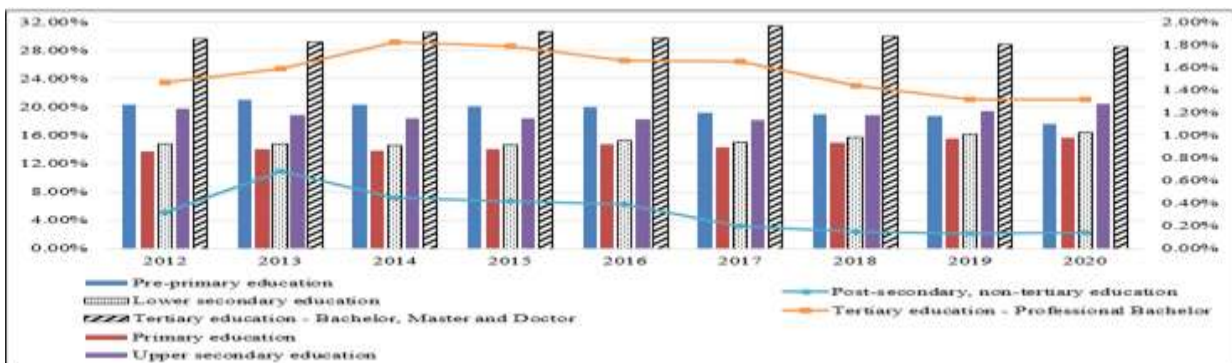Source: Own processing based on the data from [13, 14].

Fig. 4. Presentation of the obtained values of the variable P_{zk} in the 9-year time interval
Source:Own processing based on the data from [13, 14].

Thecolumns in Fig.4presentthe values of the indicator P_{zk} for fiveof the considered seven levels ofeducation (displayed on the primary vertical axis),while the lines present the

values of this mentioned indicator (displayed on the secondary vertical axis) for the other two education levels which are tertiary education-professional bachelor and post-secondary, non-tertiary education.

Quite naturally, the highest relative shares (P_{zk})are calculated for expenditures in tertiary education-bachelor, master and doctor for each year during the studied time interval.This variable reaches values between 28.46%-31.45%.Quite high values of P_{zk} are obtained for two of thestudied levels of education (pre-primary education and upper secondary education). In this case, the calculated values change in the range from17.59% to 20.99%.

The relative shares of the expenditures in the next two education levels - primary education and lower secondary education vary from 13.75% to 16.40% in the indicated 9-years period (Fig. 4).

The situation regarding the considered variable (P_{zk}) is radically different for other two educationlevels. The relative shares of expenditures in post-secondary, non-tertiary education vary from 0.68% to 0.13% in the investigated period. Slightly higher values of this variable are calculated for tertiary education - professional bachelor.In this case, the values vary in the range from 1.82% to 1.32% (Fig. 4).

The values of the mentioned-above variable C_z are visualized in the diagram of Fig. 5. The presented results for the indicator in each of the considered levels of education are summarized. The share(C_z) of expenditure for tertiary education -bachelor, master and doctorin comparison with the total expenditures for education in the indicated time period is calculated. Quite expectedly, the obtained value of the variable for this education level is the highest.It is 29.74%.The indicated expenditure is slightly less than one-third of the total expenditures in the examined levels of education.

The indicator values(C_z) for two of the considered levels - pre-primary education and upper secondary education are 19.39% and 19.01%, respectively. Here, the calculations show that each of these expenditures is slightly less than one-fifth of the total

expenditures. As can be seen from the results presented in Fig. 5, the values of C_z for primary education as well aslower secondary education are 14.66% and 15.37%.

As can be expected, the obtained values of C_z are significantly lower for the following two levels of education- tertiary education-professional bachelor and post-secondary, non-tertiary education.They are 1.54% and 0.29%, respectively.
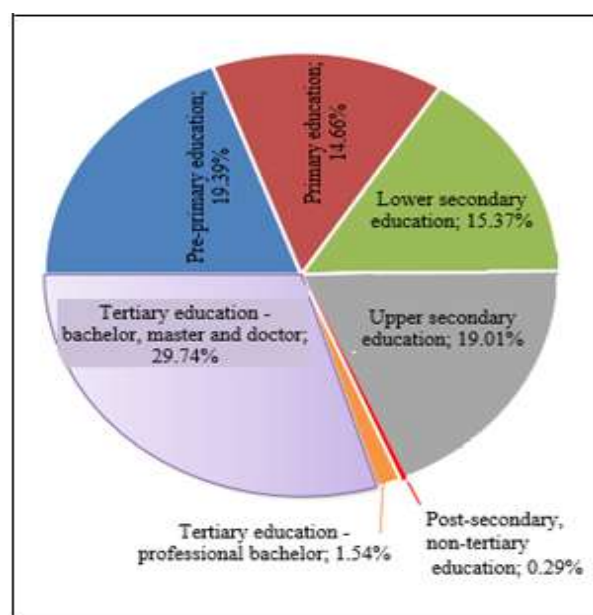

Fig. 5. Results for the variable C_z during the studied time segment
Source:Own processing based on the data from [13, 14].

CONCLUSIONS

This paper presents an algorithm for organizing and grouping data concerning the expenditures by levels of education in Bulgaria.The created database is used as a source from which the necessary information is searched depending on the entered indicators and time interval. The examined indicators include the public and private expenditures by education levels. The investigated period covers generally 9 years from 2012 to 2020.

The extracted subsets of elements are presented in separate queries.The information from these queries is processed and analyzed. In this connection, four groups of variables are calculated and discussed.Thepaper also

summarizes and visualizes the obtained results.

The expendituresin primary education are increased more than 2 times during the considered period. A similar result is obtained for theexpenditures in lower and upper secondary education and tertiary education-bachelor, master and doctor, where the growth of the studied indicator is more than 1.9, 1.8 and 1.7 times respectively, in the examined time interval. The expenditures for tertiary education-professional bachelor and pre-primary education are also increased by more than 1.6 and 1.5 times. Only the expenditures for post-secondary, non-tertiary educationat the end of the period decrease compared to the first year from the indicated time interval.

The paper also calculates the share of expenditurefor tertiary education-bachelor, master and doctor in comparison with the totalexpendituresfor educationinthe mentionedtime period.The obtained value of the variable for this education level is the highest. It is 29.74%. The values of this indicator are significantly lower for tertiary education - professional bachelor and post-secondary, non-tertiary education. They are 1.54% and 0.29%, respectively.

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