

## Mathematics and statistics in global education

Tomáš Pechočiak<sup>1</sup>, Norbert Kecskés<sup>2</sup>

Slovak University of Agriculture in Nitra<sup>1,2</sup>

Faculty of Economics and Management, Department of Mathematics

Trieda A. Hlinku 2

Nitra, Slovak republic

e-mail<sup>1,2</sup>: tomas.pechociak@uniag.sk, norbert.kecskes@uniag.sk

### **Abstract**

*Education, aimed at more thorough understanding of diversity and inequality in the world and at the causes of their existence and possible solutions to problems associated with them, is called global education. This new educational approach is gradually being implemented at all levels of education in order to bring about changes in attitudes towards these phenomena and processes in the global world and encourage solving global problems. Its implementation into courses at universities is necessary since university students are expected to have competencies that allow them to see phenomena and processes in a global environment and actively help them to solve problems in the global world. Since a relatively simple mathematical apparatus can reveal various and complicated social and economic processes, its implementation into subjects of mathematics and statistics is inevitable. The use of mathematical and statistical methods allows not only a detection of the occurrence of certain phenomena in the new global environment, but indirectly calls for particular attention. In the paper we present some problems that could serve as suggestions for the use of mathematics and statistics in training university experts for practice in a global environment.*

**Key words:** global education, mathematics, statistics

**JEL Classification:** C020, I23, I210, I240

### **1 Introduction**

The role of educational institutions in university graduates training in new global space is indisputable. Their role is to respond to the new challenges of globalization and perform graduates training in order to facilitate their successful implementation in the new global environment.

Global social problems must be understood in wider contexts of education, hence pupils and students need to acquire those values upon which they can not only understand these problems, but also to take responsibility for solving them, try to mitigate the adverse effects of globalization or to implement the necessary changes, etc. We consider relevant the training of future professionals in various fields of science who can use mathematical knowledge and knowledge of statistics not only in solving specific tasks in the field of science, but also in the wider social context. By means of quantitative indicators they can detect and then solve tasks of analytical character, such as government and economic organizations as well as business and financial organizations. Mastering of mathematical knowledge and knowledge of statistics will allow them not only to see phenomena and processes in the global environment together, but this knowledge enables them to actively approach to problem solving in the global world. The use of a simple mathematical apparatus can disclose a variety of complex social and economic processes to these students. Except for that specialized subjects provide necessary education in the conditions of the new global environment, we consider useful to extend and complement this knowledge with mathematics and statistics.

## 2 Data and methods

Global education means education that leads to deeper understanding of the diversity and inequality in the world, to the causes of their existence and to troubleshooting possibilities associated with them. It interconnects education with everyday life. Global development education includes education on issues of developing countries, global poverty, environmental education, multicultural education, peace education, as well as human rights education in a global context (National Strategy for Global Education for the period 2012 - 2016, p. 1). This kind of education should increase awareness of global issues, deepen the understanding of this phenomenon and develop critical thinking. It should help students realize its position and role in the world. We live and work in a world where we are united by a free flow of information, finance and also with people who live in distant countries. Every day we make many decisions about what we eat, what we dress, how we travel to work or school, etc. These decisions affect not only us, but also people who grow the food that we consume every day, people who sew our clothes, produce vehicles. We decide as well about the direction of international development, policy and the ways of economic development, better quality of life, how to deal with the environment (Šebeň Zaťková, 2014). For students of colleges and universities, it is desirable to acquire competencies that enable them to see phenomena and processes in a global environment of mutual relationships. We agree that "at the Slovak economic faculties it is essential to acquire the latest knowledge and skills necessary for successful future economists in the world market, but it is not enough." (Svitačová, 2013, p. 32). Young people in today's world will have to cope not only with various problems and situations whose solution requires competence and knowledge not only of the economy but also of management and other key scientific areas. Their successful participation in the global economic and social environment assumes to obtain at least basic knowledge and skills of mathematics.

"Many people use mathematical models of thinking, logical or spatial, they also use presentations, various charts, tables, formulas, models, diagrams used mainly in statistics. Therefore teaching of mathematics and statistics must be performed in order to enable students to acquire new knowledge by means of problems with diverse context, mainly from real life, to enable them to form simple hypotheses and investigate their veracity, to teach them how to properly present the mathematical contents by texts, spreadsheets, charts, diagrams, and to develop their ability to orientate themselves in plane and space. Mathematics is intended to help develop their algorithmic thinking, ability to work with instructions and create them." (Pechočiak, 2013, p.73) By means of simple mathematical relationships, various charts, diagrams and tables it is possible to explain various difficult social and economic processes. We also meet with the fact that not only students, but often educated people cannot work with fractions and percentages, often confuse the millions and billions, etc. Therefore, we think that mathematics with its apparatus is belongs to the basic and general education. In university and higher education there is paid little attention to global education in mathematics. Much more attention is paid to this new educational approach at primary and secondary schools. Therefore we decided to propose a few problems that could serve as a demonstration and suggestion for the use of global education in mathematics at colleges and universities. Teachers together with students can at mathematics and statistics lectures and seminars solve tasks which include topics on global education. Very current topics of today is the international migration, poverty, debt, multicultural relations, use of languages, application of human and civil rights, democracy, energy issues etc.

By means of mathematics it is possible to reveal the global dimension in situations and processes that take place in the new global environment. By quantitative mathematical and statistical methods it is possible to explain phenomena and processes in the global environment, the characteristics of global problems, to highlight their frequency, intensity, variability etc. or to draw attention to their prevalence and diversity. The implementation of the global dimension

into mathematics should enable students to acquire new knowledge through solving mathematical problems related to the situation in the global environment.

We have used the basic maths formulas and calculations as well as methods of maths descriptive statistics in the contribution.

### 3 Results and Discussion

Now in a few examples we present the possibility of the implementation of global education in mathematics and statistics. In the first example we show the impact of globalization on the use of languages in daily life. Today 2500-5000 languages are spoken in the world. We do not know exactly because even linguists often cannot distinguish languages from dialects, some languages extinct as nations and tribes mingle, others arise. Languages can be differentiated according to various aspects, such as according to accords and discords of language syntax and semantics, but most often according to the origin.

In 1990 (World Languages, s1) the most used languages in the world, meant as a native language, included these 10 (without arrangement): English, Russian, German, Spanish, Chinese, Arabic, Portuguese, Japanese, Hindi and Bengali. Table 1 lists the number of people who speak them. In mathematics, these data can be used to practice basic mathematical operations, calculating fractions, percentages and so on. In statistics, for example, we can practice drawing different types of graphs, calculate averages and other statistical parameters.

**Table 1: 10 most used languages of the world with the number of people**

<b>Language</b>	<b>Number of people in millions</b>
<i>English</i>	330
<i>Russian</i>	160
<i>German</i>	91
<i>Spanish</i>	265
<i>Chinese</i>	1 095
<i>Arabic</i>	190
<i>Portuguese</i>	155
<i>Japanese</i>	125
<i>Hindi</i>	250
<i>Bengali</i>	170

Source: Languages of the world.

**1. Problem.** Create a decreasing order of the languages according to the number of people who speak them. Create a graph from the table. Find out what part of people in this sample speak English.

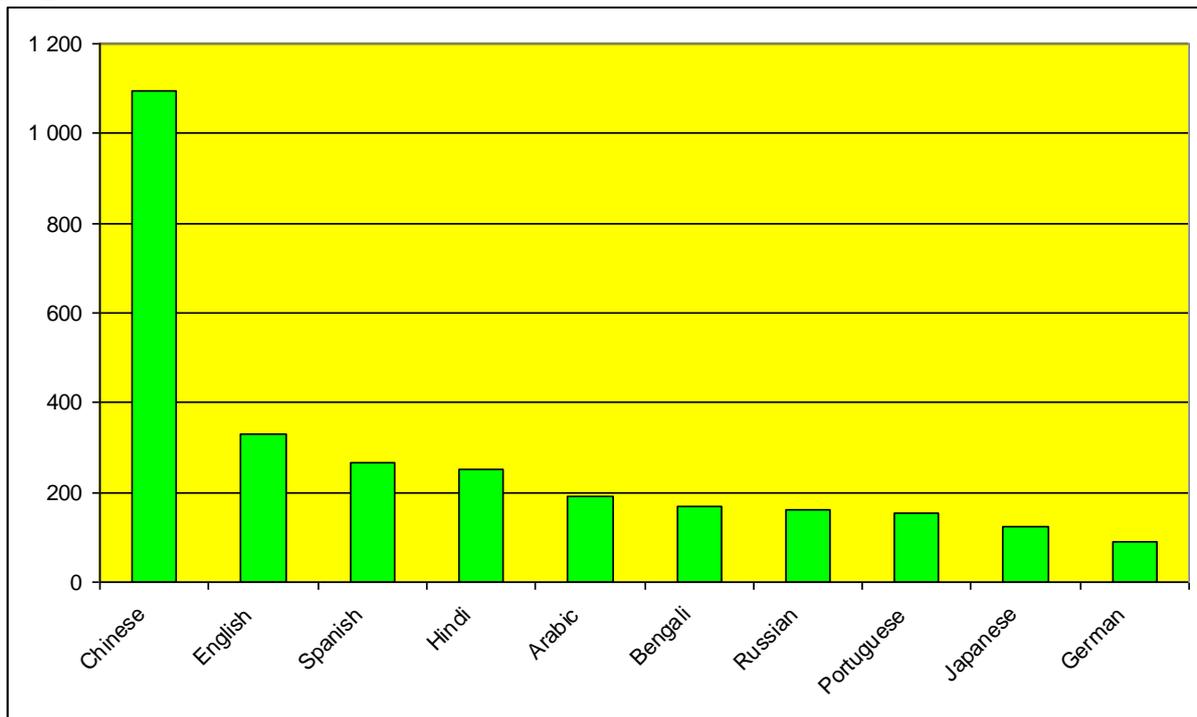
**Solution:** In Table 2, we have arranged the languages spoken by the number of people in decreasing order, and in Figure 1 there is a graphical representation of such arranged languages.

**Table 2: 10 most used languages of the world with the number of people arranged in decreasing order**

Language	Number of people in millions
<i>Chinese</i>	1 095
<i>English</i>	330
<i>Spanish</i>	265
<i>Hindi</i>	250
<i>Arabic</i>	190
<i>Bengali</i>	170
<i>Russian</i>	160
<i>Portuguese</i>	155
<i>Japanese</i>	125
<i>German</i>	91

Source: own

**Figure 1: Graphical representation of 10 most used languages of the world with the numbers of people**



Source: own

In order to solve the third part of the problem we have to sum up all numbers of people who speak these 10 languages:

$$s = 1095 + 330 + 265 + 250 + 190 + 170 + 160 + 155 + 125 + 91 = 2831. \quad (1)$$

Now we the number of English speaking people by this sum:

$$p = \frac{330}{2831} \doteq \frac{117}{1000}, \quad (2)$$

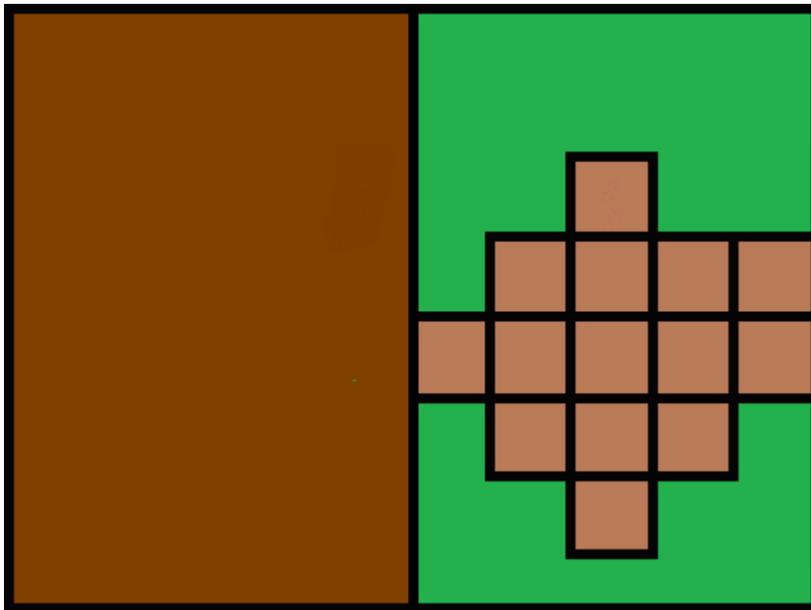
Hence English is spoken by approximately 0.117 people from the given sample, which is 11.7 % people from this sample.

We note that English, even though identified as a native language by only 330 million of people, is becoming the most widely used language of communication in the world.

Another topic of global education is agriculture. It belongs among one of the most important industries. It includes two basic sectors: crop and livestock production. Their function is to produce products required for feeding the population and also those which serve as raw materials for industry. The agricultural sector employs a significant number of working population of the world, especially in less developed countries. Farmers themselves equate land to one of the most precious metals - gold. The rapid soar in land prices implies rising food prices. The area of the agricultural land in the world is more or less constant, it cannot be indefinitely increased. The value of the land has rapidly increased in the recent years and has reached historical maxima. The soil therefore becomes a strategic production item.

In connection with a land area students could solve the following tasks. Figure 2 shows a plot of land with side lengths of 400 m and 300 m. Inside of the plot, in the right half is an ornamental garden, which the owner divided into squares with sides of 40 m, while in the corner of each square he placed a tree or a shrub.

**Figure 2: Plot with an ornamental garden**



Source: own

**2. Problem:** What part of the plot is taken by the ornamental garden? How long fence would the owner need and what would it cost if he wanted to enclose the ornamental garden, if 1 m (meter run) of fencing mesh is 1.2 €? How many kilograms of seed needs the owner to buy if he wants to seed grass around the ornamental garden if 10 m<sup>2</sup> consumes 20 g of seed (Fig. 2).

*Solution:* We calculate the area of the whole plot  $P_1$  :

$$P_1 = a \cdot b = 400m \cdot 300m = 120000m^2. \quad (3)$$

Now we calculate the area of the ornamental garden. The garden consists of 14 identical squares with sides of 40 m. Hence its area  $P_2$  is

$$P_2 = 14 \cdot c^2 = 14 \cdot (40m)^2 = 22400m^2. \quad (4)$$

We divide the area  $P_2$  by the area  $P_1$  :

$$\frac{P_2}{P_1} = \frac{22400}{120000} = 0.1867 \approx 18.67\%, \quad (5)$$

So the ornamental garden takes 18.67 % out of the total area of the plot.

In order to solve the second part of the problem we count the number of the sides of the squares which form the ornamental garden and multiply it by 40. This way we find the perimeter of the garden  $O$ , so

$$O = 20 \cdot 40m = 800m. \quad (6)$$

Since 1  $m$  of fencing costs 1.2 €, we multiply the perimeter by this number

$$c = 800 \cdot 1.2 = 960. \quad (7)$$

The owner needs 800  $m$  of fencing to enclose the garden and it will cost 960 €.

Now we solve the third part of the problem. Since the area of the whole plot is 120 000  $m^2$  and that of the ornamental garden is 22400 $m^2$ , the area of the grass is

$$P_3 = (120\,000m^2 : 2) - 22\,400m^2 = 37\,600m^2. \quad (8)$$

Seeding of 10  $m^2$  of grass requires 20  $g$  of seed, so 0.002  $kg \cdot m^{-2}$ , we multiply the area  $P_3$  by 0.002:

$$m = 37\,600 \cdot 0.002\,kg \doteq 75.2\,kg, \quad (9)$$

Hence the owner needs 75.2  $kg$  of grass seed.

#### 4 Conclusions

We can find a wide variety of similar fields and topics engaged in global education, such as poverty and inequality, health, nutrition, conflicts in the world, development goals, humanitarian aid, education towards human, civil and children's rights, gender equality, governance and democracy, multiculturalism, that could be used in mathematics and statistics,

Students should understand the interconnectedness of developed and developing countries and their mutual interaction. Economic globalization, trade, business ethics, sustainable development, as well as migration are fundamental concepts of global education. Young people should be able to identify themselves in culture, tolerate cultural differences; they should be able to lead intercultural and interreligious dialogue, to handle the concepts of racism, intolerance, xenophobia and various prejudices. An important component of global education is environmental education. Climate change, pollution of air, water and soil, waste management, but also the use of natural resources, creation of alternative energy sources should be the topics encountered by students in the learning and educational process.

Mathematics and statistics are subjects in which we can discuss problems of global education. Education in mathematics and statistics is based on a realistic approach to the acquisition of new knowledge and to the use of manual and intellectual activities for developing of a variety of different skills. Very important is the application of mathematical and statistical knowledge in real situations. In this way students acquire the knowledge and skills of a new quality, which should be present in the entire mathematical and statistical education and create preconditions for further study of mathematics and statistics as well as for lifelong learning.

#### References

- [1] National Strategy for Global Education for the period 2012 - 2016. (2012). Retrieved February 10, 2016, from [http://www.statpedu.sk/files/documents/odborne\\_info/narodna\\_strategia\\_globalne%20vzdelavanie\\_2012\\_2016.pdf](http://www.statpedu.sk/files/documents/odborne_info/narodna_strategia_globalne%20vzdelavanie_2012_2016.pdf)
- [2] Pechočiak, Tomáš. (2013). Globálne rozvojové vzdelávanie a matematika. In: *Zborník recenzovaných vedeckých prác: Globálne rozvojové vzdelávanie v edukačnom procese na ekonomických fakultách*. Nitra: Slovenská poľnohospodárska univerzita, s. 71–76. ISBN 978-80-552-1087-2
- [3] Svitačová, Eva. (2013). Globálne rozvojové vzdelávanie na ekonomických fakultách. In: *Academia*. roč. XXIV, 1-2. s. 31-39. ISSN 1335-5864

- [4] Šebeň Zaťková, Tímea a kol. (2014). *Globálne rozvojové vzdelávanie na ekonomických fakultách*. Nitra, Slovenská poľnohospodárska univerzita v Nitre, 107s. ISBN 978-80-552-1266-1

\* Online full-text paper availability: doi:<http://dx.doi.org/10.15414/isd2016.s8.13>