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Ukraine (Dnipro) – 2021

Chemical sciences

CHEMICAL CHARACTERIZATION OF SRI LANKAN DOLOMITE FOR WASTE WATER TREATMENTS

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Abstract. *Dolomite is a prominent industrial mineral which is having a vast range industrial uses. Usually dolomite is found in hydrothermal veins, pegmatite and some sediment alone or allied with some other minerals such as calcites at various deposits around the world. The Matale area in Sri Lanka is a famous region for the deposits of dolomite rocks. The chemical characterization and prognosis of the advanced industrial uses of dolomite which is available in Matale region in Sri Lanka were the intentions of the existing research. The dolomite rock samples were collected nearby the Matale, Sri Lanka. The collected samples were*

chemically characterized using X-ray fluorescence (XRF) spectrometer, Fourier transform infrared (FT-IR) spectrometer and also the dolomite samples were microscopically characterized using an optical microscope. According to the fundamental results of the experiments, there were observed 99.4% of Ca and 0.5% K as the composed elements with respect to the X-ray fluorescence (XRF) analysis, composed the majority of dolomite without having other accessory minerals or functional groups with respect to the Fourier transform infrared (FT-IR) analysis and the colorless, reddish brown and white particles with tabular crystals and curved faced under the microscopic analysis. As the overall investigation of this experiment, it is possible to conclude the purity of this rock in dolomite is higher and less contaminated. Therefore, these dolomite/ dolomite rocks may have some better performances in the processes of the reduction or removal of the temporary hardness of water which is caused by the carbonates in water, adsorption agent (adsorber) for some of heavy metals such as Pb and Cd in the form of powdered and removal or recovery material for some chemical compounds such as phosphates.

Keywords: *Dolomite, FT-IR characterization, XRF characterization Advanced microscopic analysis, SEM analysis, Water treatment uses*

Introduction. Dolomite is an economically valuable mineral which is known as an industrial mineral. Usually the mineral dolomite is found that associate with dolomite rocks (lime stones) most probably with the mineral calcite which is having much similar characteristics of dolomite [1-4]. The general physic-chemical profile of dolomite is described in the Table 1 [1-6].

Table 1. General characteristics of dolomite

Characteristic	Description
Chemical formula	$CaMg(CO_3)_2$
Color	Colorless, white, pale brown, grayish white, reddish white, pink, greenish white, pale black
Streak	White
Luster	Vitreous, pearly
Hardness	3.5
Magnetism	None
Density (gcm^{-3})	2.9
Diaphaneity	Transparent, translucent
Tenacity	Brittle
Cleavage	Non-evident
Crystal system	Trigonal

According to the existing industrial applications of such dolomites, mainly the lime productions for building materials and some of advanced chemical applications such as the production of CaC_2 can be emphasized [2, 4, 5, 6-10]. Apart from that a large number of research and investigations are being progressed with the advanced chemical and water treatment applications of different dolomite types. In the existing research there were expected to characterize a selected dolomite variety in Sri Lanka in chemically and microscopically based upon the investigations of some outstanding characteristics of such dolomites and finding of the applicability of some of advanced chemical and water treatment applications in the modern research world.

Materials and Methodology. The dolomite samples were collected nearby the relevant quarry which is located in Matale region in Sri Lanka. The collected dolomite chips were stored in cleaned polythene bags while preventing the contamination with foreign materials. The stored dolomite chips were further processed as necessary for the experiments using standard apparatus, chemical agents and methodologies.

Figure 1. Dolomite chips (comminuted dolomite masses)

A few of batches of randomly selected dolomite chips were collected and washed them with distilled water and oven dried for 24 hours at 110C until the removal of moisture. The dry dolomite chips were crushed using mechanical crushers, ceramic crucibles and ball mills and it was experienced the brittle property. In the selections of particles sizes the 0.075mm sieve mesh was taken as the indicator and the <0.075mm portion was selected for the experiments.

Figure 2. Powdered dolomite masses

In the selections of final representative samples of the coning and quartering method was followed as shown in the Figure 3. The coning and quartering method is a technique that can be applied in the selections of a reasonable representative sample from a large amount of powdered solid materials such as clay, sand and powdered minerals.

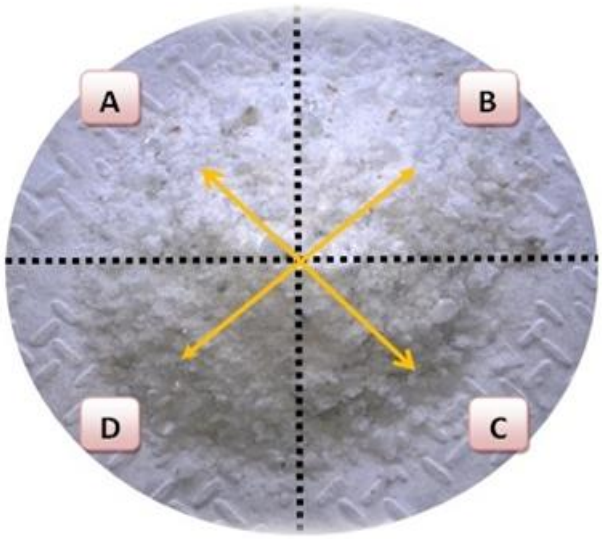

Figure 3. Coning and quartering method

The prepared representative samples were transferred for following instruments based upon following relevant analysis.

- X-ray fluorescence (XRF) spectrometer - Elemental analysis
- Fourier transforms infrared (FT-IR) spectrometer - Chemical structural and functional group analysis
- Optical microscope - Analysis of the particle shapes, diaphaneity and colors
- Scanning electron microscope (SEM) - Analysis of crystal systems, crystal shapes and microstructures

Figure 4. X-ray fluorescence (XRF) spectrometer

Figure 5. Fourier transforms infrared (FT-IR) spectrometer

Figure 6. Optical microscope

Figure 7. Scanning Electron Microscope (SEM)

Results and Discussion. The X-ray fluorescence (XRF) analysis results of dolomite are shown in the following figure and table.

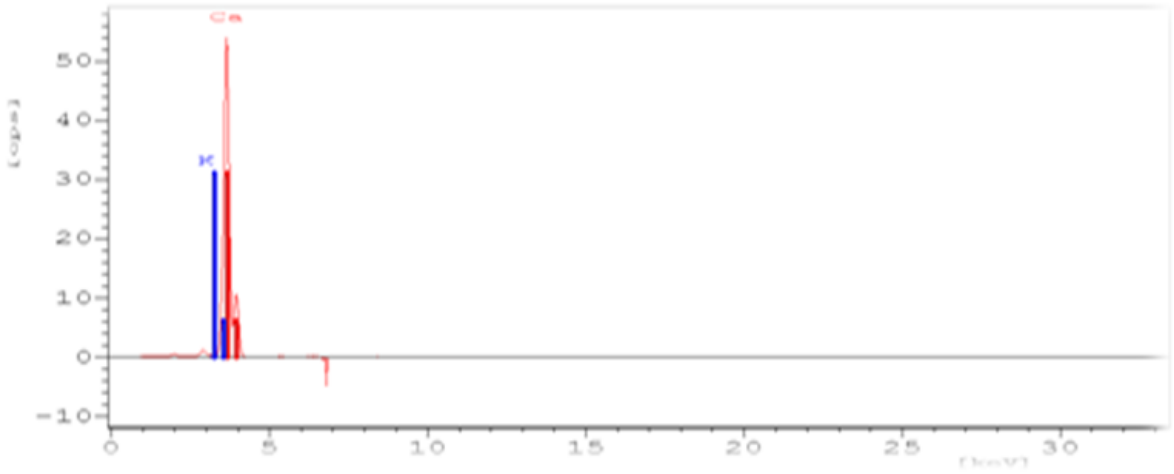

Table 2. Elemental chemical composition of dolomite

Element	Content (%)
Ca	99.46
K	0.54

According to the above results, it seems that this dolomite type was composed with relatively higher amount of calcite because of the higher Ca content while it was not observing evidence about Mg which is a major element that presence in dolomite [1,3,4,5,6,8,9,10]. This would be an alkaline dolomite variety because of the presence of K.

The Fourier transforms infrared (FT- IR) spectroscopy and assignments of dolomite are shown in the following figure and table.

Figure 9. Fourier transforms infrared (FT-IR) spectroscopy of dolomite

Table 3. Chemical structural analysis of dolomite

Wave Number (Cm^{-1})	**Assignment**	**Wave Number (Cm^{-1})**
729	Si-O stretching of feldspar	729
881	Out plane bending of calcite	881
1433	CO_3 stretching	1433
2365	-	2365
3699	OH stretching	3699

According to the above results, it can be concluded that the presence of outer planer bending and CO_3 stretching which are presence in both calcite and dolomite [2, 3, 5, 6, 8, 9]. Since the FT-IR spectrums of calcite and dolomites are much similar, it is much knotty to distinguish the calcite or dolomite alone with FT-IR results [1-6].

A few of optical micrographs of dolomites are shown in the following figures.

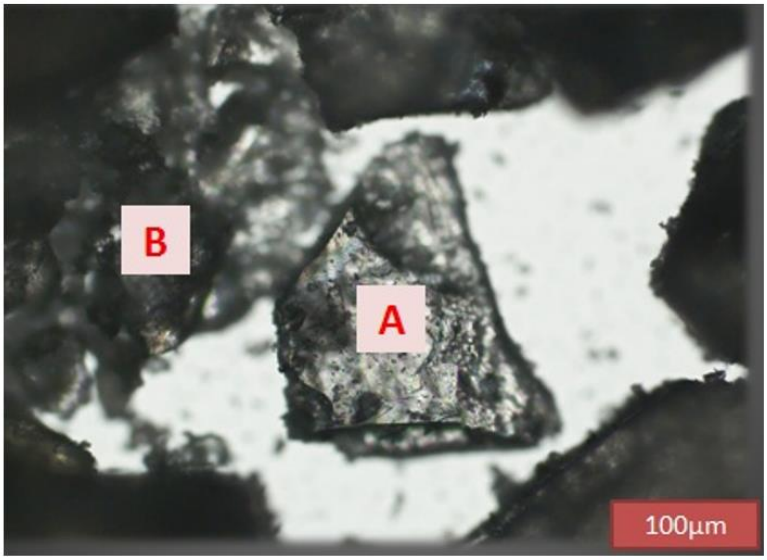

Figure 10. An optical micrograph of dolomite

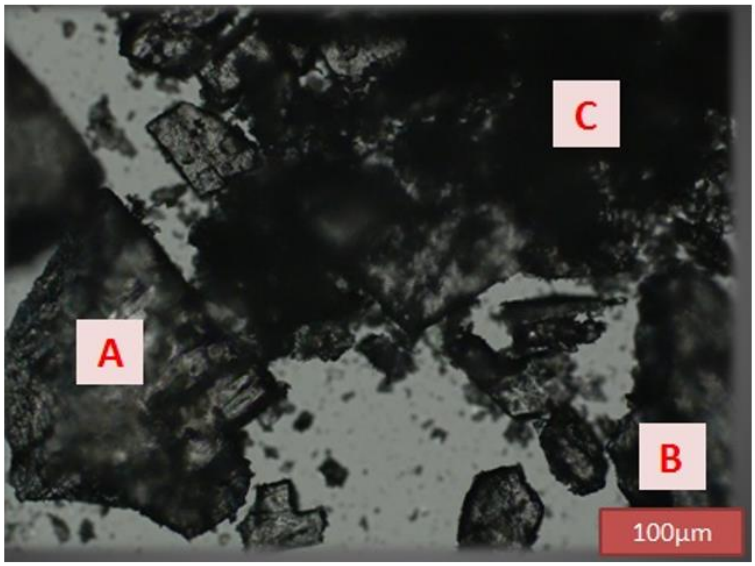

Figure 11. An optical micrograph of dolomite

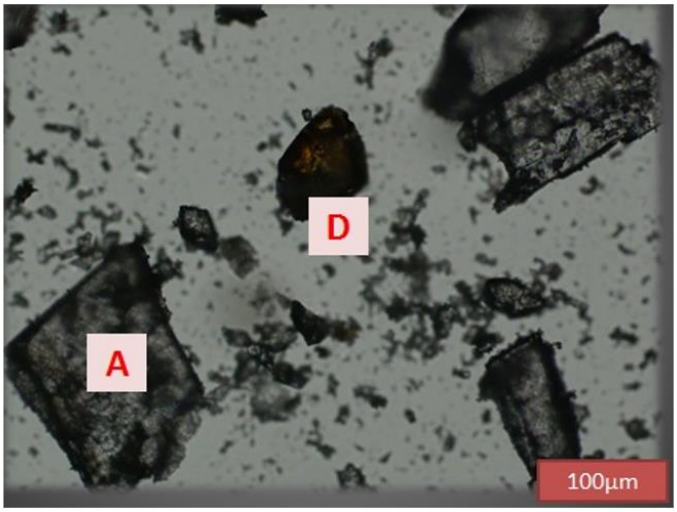

Figure 12. An optical micrograph of dolomite

According to the above optical micrographs, following important observations were captured.

- A- Tabular and massive crystals with some flat surfaces, curvatures, cavities and ripple marks on the crystal surfaces with cleavages
- B- Colorless crystals and white crystals
- C- Transparent or translucent crystals
- D- Reddish color crystals in trace percent

A few of SEM micrographs of dolomites are shown in the following figures.

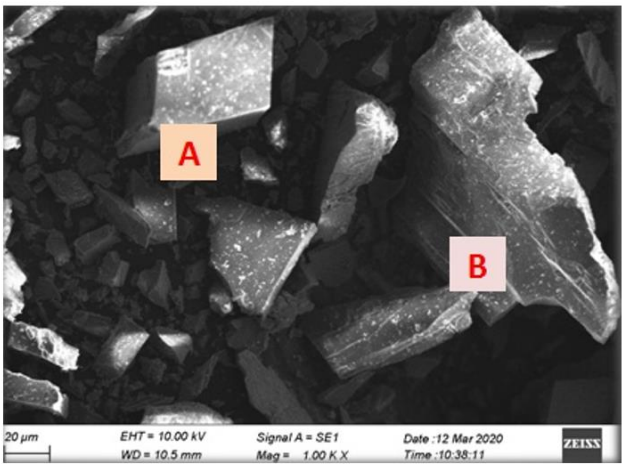

Figure 13. SEM micrograph of dolomite

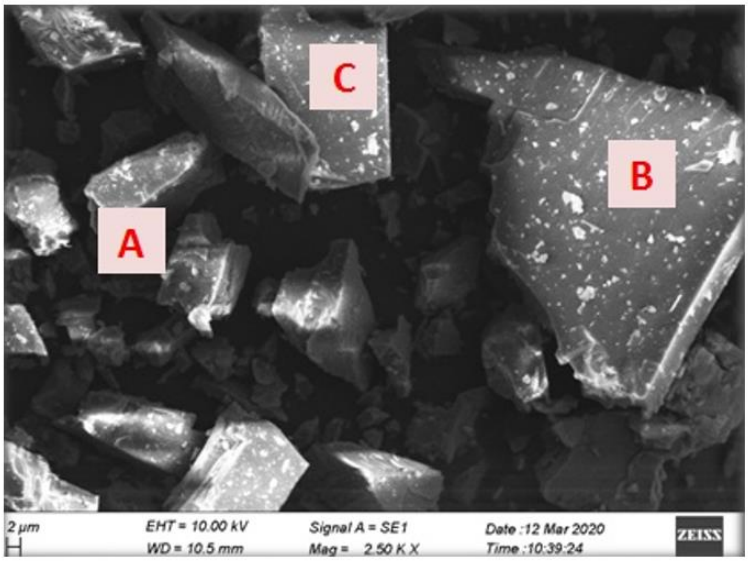

Figure 14. SEM micrograph of dolomite

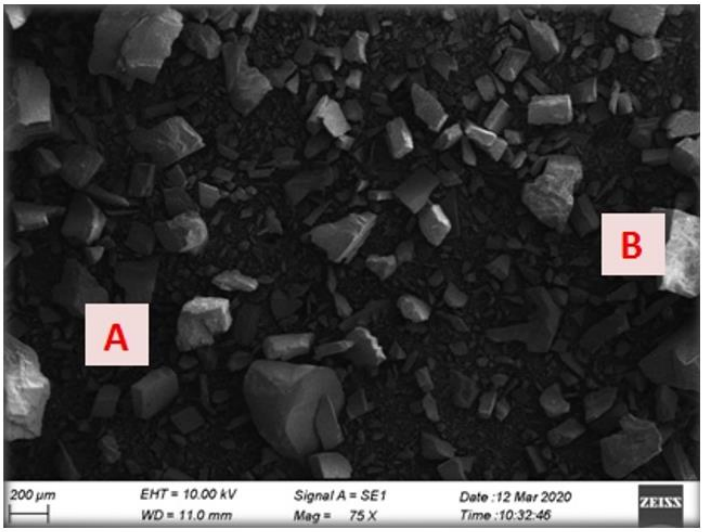

Figure 15. SEM micrograph of dolomite

According to the above SEM images, following important observations were capture.

- Cleavage planes and tabular crystals
- B- Massive crystals and flat surfaces
- C- Curve shaped surfaces and ripple marks

Based upon the above observations, it is confirmed the presence of large amount of calcite since having less impurities this dolomite type [1, 3, 4, 5, 7, 8].

In the consideration of the observed characteristics of these dolomites, it is possible to recommend following advanced applications with the necessary synthesis methods [1, 2, 4, 6, 9, 10].

- Removals of heavy metals, pathogens and hardness from the waste water because of the adsorption capacities of $CaCO_3$ and $CaMgCO_3$ as massive bodies, chips and nano particles.
- Removal of pathogens, organic matter, suspended solid particles and heavy metals from waste water in the forms of CaO (burnt calcite/dolomite) as nano particles and $Ca(OH)_2$ (production of the reaction of both CaO and water) as nano particles. (in the synthesis of nano-particles it is required some standard chemical and physical synthesis methods)
- Removal of the hardness from extra-hard water and adjusting the acidity of water as dolomite and calcite bodies due to the adsorption.
- It can be used as a recovery material for some unnecessary compounds that dissolved in water such as phosphates.
- Also it can be developed as a refractory material because of CaO and $CaCO_3$.

Conclusion and Recommendations for Future Works. This type of dolomite rock was composed relatively higher amount of calcite with trace amount of dolomite with crystal surfaces and brittle structure. Therefore, it is possible to recommend this dolomite type for the uses in the removals of hardness, pathogens, heavy metals, suspended solids and controlling of the acidity as the massive forms and also the nano-forms of CaO and $Ca(OH)_2$.

- Entire compositional analysis of this dolomite rocks using an advanced analysis method such as Neutron Activation Analysis (NAA).
- Advanced microscopic analysis of this dolomite rocks such as Transmittance Electron Microscope (TEM).
- Development of dolomite nano-materials and experimentations of their absorption capacities and catalytic strength.

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- Voluntary material providers (dolomite)
- Department of Chemical and Process Engineering, University of Peradeniya
- Department of Physics, University of Peradeniya
- Department of Chemistry, University of Peradeniya
- Department of Zoology, University of Peradeniya
- Department of Material Science and Engineering, University of Moratuwa

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Economic sciences

USE OF RENEWABLE ENERGY IN SELECTED COUNTRIES

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Abstract. *In recent years, energy and climate issues have come to the forefront of the general public's attention, even though the negative links between energy consumption and global warming have been known for decades. With the adoption of the Paris Climate Agreement in December 2015, international climate policy began to change from the ground up, and this agreement has given countries new power to promote policy incentives for clean energy development. Among the most important agreements between countries to combat climate change is the Paris Agreement. The Paris Agreement was adopted on 12 December 2015 and was the result of a very long process. To qualify and enter into force, the agreement had to be adopted or ratified by at least 55 countries that account for at least 55% of global greenhouse gas emissions. The big breakthrough came on April 1, 2016, when the U.S. and China together publicly issued a statement that they would accept and sign the agreement. This was a big deal from the agreement's supporters, as the two countries represented nearly 40% of global emissions generated in 2018. This also contributed to 175 leaders (174 countries*

and the EU) signing the Paris Agreement on the first possible day. This was a record for the number of countries signing an international document in one day (21.4.2016). A few months later, on 4.10.2016, the EU officially ratified the Paris Agreement. Approximately one year after its adoption, the Paris Agreement entered into force on 5.11.2016. Then something no one imagined happened on 4.11.2020, when the USA, as the world's second largest CO2 emitter, withdrew from the Paris Agreement. It thus became the first and only country to do so. However, the recent election of the US President in November 2020 has sent a positive message to the world. Joe Biden was elected and re-joined the Paris Agreement on 19 February 2021. As of 5 December 2020, 194 leaders have signed the Paris Agreement and of these, 189 have ratified, accepted, endorsed or otherwise acceded to it.

It is not only climate change, but also the dwindling supplies of energy commodities and the growing import dependence of European countries that is creating significant vulnerability for countries. The Member States of the European Union are calling for a rapid transformation of the way energy is obtained. Environmentally sound solutions that are consistent with sustainable economic development are represented by renewable energy sources (RES), which could comprehensively replace conventional energy sources within decades. Energy systems around the world are currently facing significant changes and the renewable energy sector has become one of the rapidly changing and transforming sectors of the world economy in recent years. Despite the general desire to switch to green energy, there is a distrust of renewables and their potential is often underestimated.

Currently, fossil fuels have the highest share of the world's energy production. The reserves of these fossil fuels, which are oil, natural gas and coal,

are gradually being depleted. Their use in almost all areas of our daily lives is gradually depleting their resources and it is not with our power to renew them. The longevity of these reserves is increasingly being debated by various experts. However, we can say without a doubt that one day they will run out. Some sceptics even predicted their complete exhaustion as early as the beginning of the 22nd century. Renewable energy sources are now at the heart of the energy policies of all the countries of the world. The climate summit held in Paris in December 2015 testifies to this. In the context of this summit, the Slovak Association of the Photovoltaic Industry (hereinafter SAPI) stated that it believes that renewable energy sources are an effective tool for saving the climate. The global summit in Paris represents a chance to agree on a global warming slowdown that will avoid the worst catastrophic scenarios.

Everyone needs different kinds of energy for his daily survival and activity. The first law of thermodynamics tells us that energy in an isolated system cannot spontaneously arise or dissipate. However, the type of energy can change. Thus, man cannot create energy, but he can change it. Therefore, in recent decades, the world has been focusing more on renewable energy sources (hereinafter RES) in order to protect planet Earth and not to exhaust all non-renewable resources in the form of fuels. Renewable energy sources are energy sources that are able to renew themselves naturally, or if a particular resource is depleted, it will be depleted in thousands to billions of years - for example, as long as the sun continues to shine. RES are a primary energy source that can renew itself continuously. The Paris Agreement leaders established as itself a large number of targets and by them seek to influence the problems caused by global warming. The Paris Agreement leaders have set as a major goal to significantly limit the current rise in global temperature.

Many experts and scientists, also mentioned in this article, for example Cho, Renee, Mccarty, John Blau, Judith have been warning for a long time that failure to address the problem of climate change could have disastrous consequences for future generations. Failure to address these issues would mean a gradual increase in ocean and air temperatures. Without the necessary changes in world energy policy, daytime temperatures around the equator could reach 76 ºC by 2100. These temperatures would mean unbearable conditions for life in these areas. The consequence would be an increasing migration of populations to colder areas. Not only would the air temperature change, but also the temperature of the oceans, resulting in serious ecological disasters.

Subsequently, steady warming will raise ocean levels by 3.3 millimetres each year. According to recent reports, at the current trend, ocean levels would rise 65 centimetres by 2100, state This would cause serious problems for most coastal cities. The US cities most at risk are those located in the east, such as New York, but also cities on islands such as Tokyo and Singapore. On the European continent, the Netherlands, which is below sea level, is most at risk. European coastal cities, such as Venice, which are regularly flooded, are also at risk. The water thus threatens the historic part of the city and many of its monuments.

The V4 countries do not have to deal with these very serious problems because, due to their geographical location, apart from Poland, they are deep inland. A major risk for Slovakia in particular may be the melting of mountain glaciers, which cause an increase in river beds and consequent flooding in areas located close to water.

In this paper we will analyse renewable energy sources in selected countries, namely the V4 countries - Czech Republic, Poland, Hungary and Slovakia.

According this background, the European Union (hereinafter EU) decided in 2020 to offer a solution to this situation in the form of the 20-20-20 strategy. This is the European Union's Climate and Energy Package, which was focuses on improving the quality of the environment and averting climate disasters. The V4 countries within the European Union have also joined this strategy, thus committing themselves to improving electricity consumption, reducing greenhouse gas emissions and making greater use of renewable sources in energy generation. We will focus on the impact of the European Union's Climate and Energy Package on these selected countries, focusing on the Visegrad Four countries (hereinafterV4). We will define more precisely what support policies the V4 countries have implemented in their programmes and what renewable energy sources are used in their countries. Based on the statistical data collected from the V4 countries and from Eurostat, SHARES Summary results 2021, we will conclude, how the V4 countries are on track to achieve their national targets in 2020.

Based on our analysis, we can state that among the Visegrad Four countries, Slovakia and the Czech Republic are really the winners in 2019, having managed to meet their national targets several years ahead of schedule and are about 3% percentage points above their target. Slovakia has made the biggest step, improving its performance by 5% compared to 2018, to 16.9% in 2019. Slovakia´s sharp improvement in performance was due to an almost twice times year-on-year increase in the use of renewables in the heating and cooling sector. In 2018, renewables were used for 10.6% of this sector's share, and in 2019 it is already 19.7%. For a long time, Hungary was above its target, but from 2018 we can observe a downward trend. Hungary was at 14.5% in 2015, but finished with 0.4% below its target of 13% in 2018. Poland is also among the countries that are well behind their target. Poland among the V4 countries, it is the worst performer

in 2019, with a share of 12.2%, and is almost 3 percentage points behind its target. For these comparing, we have drawn the data from Eurostat, SHARES Summary results 2021.

Another target set by the V4 countries, in line with the European directive, was to reduce share of greenhouse gas emissions by 20% by 2020 compared to 1990. According to the latest published data, in 2018 the EU exceeded this target and reduced its greenhouse gas production by 20.7% compared to 1990. At the same time, 2019 is expected to see the steepest year-on-year decline with 4%, which would be the most in a decade, according to Total greenhouse gas emission trends and projections in Europe. The positive results have forced the EU to renegotiate its previous plans and adjust its targets. The EU has decided to change its initial target of a 40% reduction in greenhouse gas emissions by 2030 and to increase this target to 55% compared to 1990.

Another goal is to become the first climate-neutral continent by 2050.

The last of the key objectives of the 20-20-20 strategy is to make electricity use 20% more efficient than it was projected to be in 2007. This means that the EU's total energy consumption should be no more than 1 086 million tonnes of oil equivalent of final energy. EU countries are being asked to use electricity more efficiently at all stages of the energy chain, from generation, transmission, distribution to final energy consumption. At the same time, the EU has set a target for 2030 to improve the efficient use of electricity by 32.5% compared to the model developed for 2030.

Keywords: *renewable energy sources, V4 countries, Paris Agreement, greenhouse gas emissions*

Methodology and goal. In this paper, we have used several scientific methods, starting with collecting information, especially from scientific works from both foreign and domestic authors. Subsequently, we have sorted them into individual chapters. From the scientific methods we mainly used paired methods such as induction and deduction, analysis and synthesis. By using the method of observing data in the analysed period, we stated the conclusions. For a better presentation of the obtained results, we used graphical and mathematical methods, which are mainly used for a clearer presentation of our results in the tables and charts. The aim of the article is to point on using of RES in European Union and especially in V4 countries.

Results. The aim of the paper is to point out the results of the use of RES in accordance with the Strategy 20-20-20, which was set by the European Union and its implementation, especially in the V4 countries. We will start with the analysis from 2004. The share of energy generated from RES to the final energy consumed was almost the same in these selected countries. Hungary had the lowest share of energy consumed from renewable sources - 4.4%. In 2004, Poland had the best ratio of energy consumed from renewable sources - 6.9%. The second place belonged to the Czech Republic with a share of 6.8% and finally to Slovakia with a share of 6.4%. If we look at the results achieved in 2019, we see that our selected countries have achieved different results. Hungary had long period remained above its target 13%, but in recent years we can see a declining trend. Hungary was at 14.5% in 2015, but reduced its efforts and in 2018 0.4% is below its planned target of 13%. Among the countries that lag far behind their target are also Poland. In 2019 had with its share of 12.2% lags behind its target 15%, what is negative difference 2.8%. This is mainly due to the high share of coal in its total share of electricity produced and distributed. The last of the key targets of the 20-20-20

strategy is to improve electricity efficiency by 20% compared to 2007 levels. This means that total energy consumption in the EU should be no more than 1 086 million tonnes of oil equivalent of final energy. EU countries are being asked to use electricity more efficiently at all stages of the energy chain, from generation, transmission, distribution to final energy consumption. (Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency).

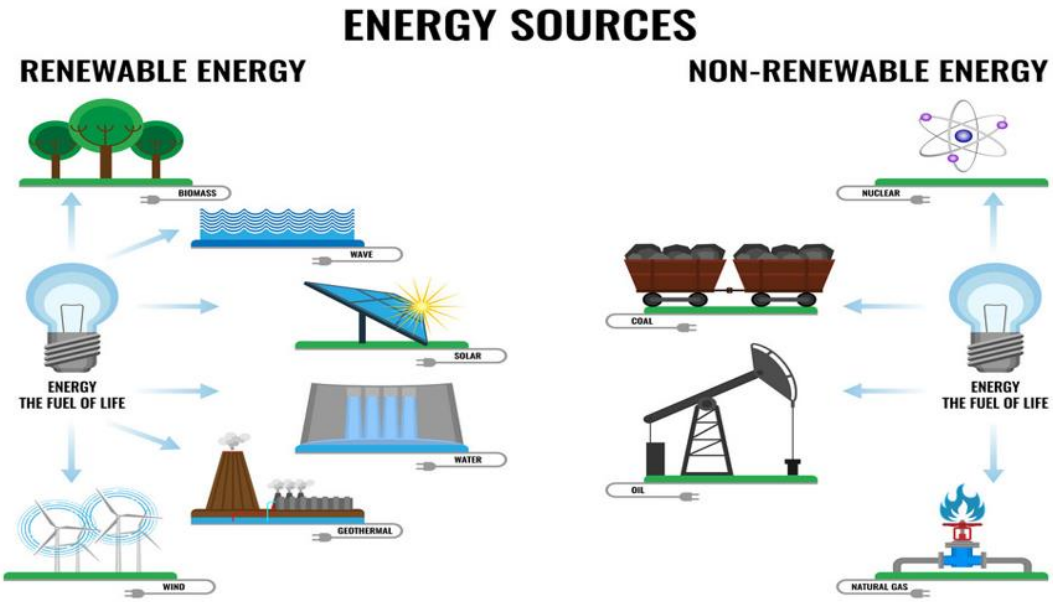
Introduction. The European Union has faced to many challenges in recent years. Between 2008 and 2012, a financial crisis has escalated over the whole world, the effects of which are still being felt today. In spite of the different ideologies and opinions of individual countries, almost the whole world has been able to agree that climate change is a problem that must be tackled immediately. It is precisely by slowing down the effects of climate change that countries have been able to come together to put aside their differences and take significant action to tackle the problem of climate change, which could have disastrous consequences for future generations. Failure to address these issues would mean also a gradual rise in ocean and air temperatures. Without the necessary response, daytime temperatures around the equator could climb to 76 ºC by 2100. These temperatures would mean unbearable conditions for life in these areas. [1,2] The concept of environmental protection on a global scale has resulted in a common solution to technological, geopolitical and economic issues. Energy as a whole play a significant role in each country in terms of national security. This is primarily because if there is not enough energy, the economy cannot function reliably, and if the economy does not function efficiently, there cannot be lasting progress in society. It is this key element that is being exploited by the world's largest countries, which are trying to find long-term solutions to the issue of energy

security by reducing dependence on foreign imports of energy carriers. It is this fact that is leading to an increasing of the use of domestic renewable energy sources. At the same time also to various measures aimed at energy efficiency and energy savings. The concept of energy security has evolved as a means to build of physical infrastructure, which serve to their concrete supply in sufficiency of all energy resources, in the necessary volume, time and price. We can estimate it for all end-use sectors of a country or for each sector separately. [3]

1. Current issues in the RES Solutions

Renewable energy sources do not deplete the environment like as non-renewable sources, but yet their use is not higher because they also have significant disadvantages. [4] So zvyšujúcim sa podielom využívania obnoviteľných zdrojov energie bude hlavným cieľom modernizácia elektrickej siete, aby bola inteligentnejšia, bezpečnejšia a lepšie integrovaná vo všetkých regiónoch.

With the increasing use of renewables, the main goal will be to modernise the electricity nets to make it smarter, safer and better integrated in all regions of EU. [5] There are several types of renewable energy from which energy is produced, these are mainly sun, wind, sea and water. The consumption of energy from these renewable sources has increased a lot in recent years. In 2017, renewables provided 17% of Europe's electricity and now cover up to one third (1/3) of Europe's energy mix. [6]



Picture 1: Types of energy sources

Source:https://www.vectorstock.com/royalty-free-vector/renewable-and-non-renewable-energy-sources-poster-vector-14631464

Perhaps the worst problem associated with the consumption of fossil fuels is the release of carbon dioxide, or so-called "greenhouse gases", which is a major contributor to the problem of climate change. [7] In this context, therefore, the Paris Agreement has set a large number of targets that seek to influence the problems caused by global warming. The Paris Agreement leaders have set as their main objective to significantly limit the current rise in global temperature. In the last 140 years, five of the warmest years have occurred since 2015, and in the same period, 9 of the 10 warmest years have occurred since 2005. Currently, the world is on level of increase temperature for a 1°C increase in global surface temperature compared to pre-industrial times, what is the highest global temperature on record.

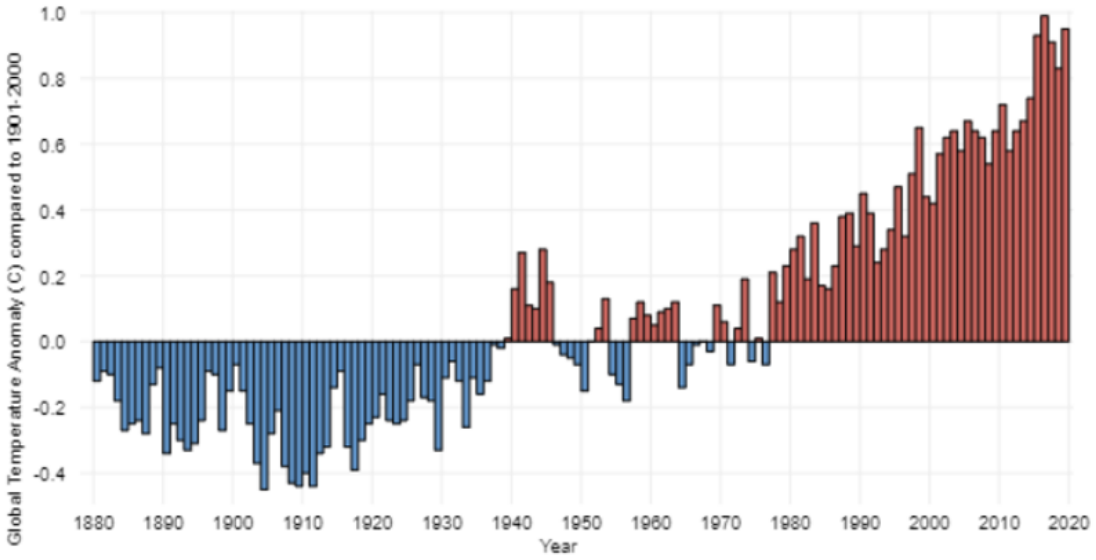


Chart 1: Global surface temperatures from 1880 - 2020

Source: Lindsey, R.–Dahlman, LuAnn. *Climate Change: Global Temperature*. 2021. available on: https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature

From this chart we can see how global temperature has evolved over time from the industrial era. The average increase in global temperature since 1880 has been about only0.07 °C per decade. However, since 1981 the average increase has more than doubled to 0.18 °C per decade. Therefore, the Paris Agreement set as the main objective reducing this global temperature increase to 1.5 °C compared to the pre-industrial period. The Paris Agreement has thus become a major international document by which countries have pledged to take even greater care of the environment in order to limit the problems caused by global warming. [8] Humans are responsible for almost overall of the increase in greenhouse gases in the atmosphere over the last 150 years. Greenhouse gases are found in the atmosphere,

where they absorb long-wave infrared radiation, causing the lower atmosphere and the Earth's surface to warm. [9]

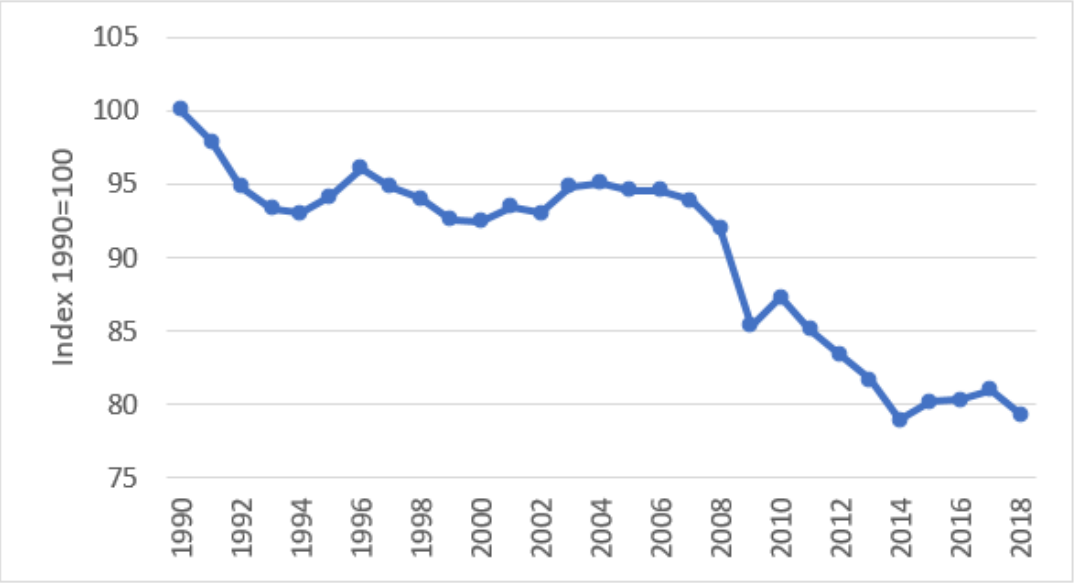


Chart 2: Greenhouse gas emissions trend in EU 27

Source: Eurostat. *Greenhouse gas emissions, base year 1990*. 2021. available on: https://ec.europa.eu/eurostat/databrowser/view/t2020_30/default/table?lang=en

That is why the European Union has chosen as its next target to reduce greenhouse gas emissions by 20% by 2020 compared to 1990. According to the latest published data, the EU has already exceeded its target in 2018, reducing greenhouse gas production by 20.7% compared to 1990. [10]

The European Union's climate and energy package was presented at the European Council on 8 and 9 March 2007 and consisted of a large number of measures to help combat climate change. On 11 and 12 December 2008, the European Council finally adopted this package under the name of the 20-20-20 Strategy, which focuses on 3 key objectives that the EU should achieve by 2020:

- 20% reduction in greenhouse gas emissions compared to 1990,

- 20% of the EU's energy should come from renewable sources,
- 20% improvement in the use of electricity.

Another important goal is trying to reduce the negative effects of climate change was the mandatory 10% share of biofuels in transport (Smernica Európskeho Parlamentu a Rady 2009/28/ES z 23. apríla 2009 o podpore využívania energie z obnoviteľných zdrojov energie a o zmene a doplnení a následnom zrušení smerníc 2001/77/ES a 2003/30/ES). Each EU Member State had a national binding target for 2020, relative to their capabilities. The common target was to increase the share of energy generated from renewable sources to 20% of the total energy consumed in the EU. The minimum level for the V4 countries was 14% for Slovakia, 13% for the Czech Republic, 15% for Poland and 13% for Hungary.

Table 1: Share of RES v EU

	2004	2015	2016	2017	2018	2019	2020 target
EU27 z 2020	9,6%	17,8%	18,0%	18,5%	18,9%	19,7%	20,0%
EU28	8,6%	16,7%	17,0%	17,5%	18,0%	18,9%	20,0%
Belgium	1,9%	8,0%	8,8%	9,1%	9,5%	9,9%	13,0%
Bulgaria	9,2%	18,3%	18,8%	18,7%	20,6%	21,6%	16,0%
Czech Republic	6,8%	15,1%	14,9%	14,8%	15,1%	16,2%	13,0%
Denmark	14,8%	30,9%	32,1%	34,7%	35,4%	37,2%	30,0%
Germany	6,2%	14,9%	14,9%	15,5%	16,7%	17,4%	18,0%
Estonia	18,4%	28,5%	28,7%	29,2%	30,0%	31,9%	25,0%
Ireland	2,4%	9,0%	9,2%	10,5%	10,9%	12,0%	16,0%
Grece	7,2%	15,7%	15,4%	17,3%	18,1%	19,7%	18,0%
Spain	8,3%	16,3%	17,4%	17,6%	17,5%	18,4%	20,0%
France	9,5%	14,9%	15,5%	15,9%	16,4%	17,2%	23,0%
Croatia	23,4%	29,0%	28,3%	27,3%	28,0%	28,5%	20,0%
Italy	6,3%	17,5%	17,4%	18,3%	17,8%	18,2%	17,0%
Cyprus	3,1%	9,9%	9,9%	10,5%	13,9%	13,8%	13,0%
Latvia	32,8%	37,5%	37,1%	39,0%	40,0%	41,0%	40,0%
Lithuana	17,2%	25,7%	25,6%	26,0%	24,7%	25,5%	23,0%
Luxemburg	0,9%	5,0%	5,4%	6,2%	9,0%	7,0%	11,0%
Hungary	4,4%	14,5%	14,4%	13,5%	12,5%	12,6%	13,0%
Malta	0,1%	5,1%	6,2%	7,2%	8,0%	8,5%	10,0%
Netherlands	2,0%	5,7%	5,8%	6,5%	7,3%	8,8%	14,0%

Austria	22,6%	33,5%	33,4%	33,1%	33,8%	33,6%	34,0%
Poland	6,9%	11,9%	11,4%	11,1%	11,5%	12,2%	15,0%
Portugal	19,2%	30,5%	30,9%	30,6%	30,2%	30,6%	31,0%
Romania	16,8%	24,8%	25,0%	24,5%	23,9%	24,3%	24,0%
Slovenia	18,4%	22,4%	21,5%	21,1%	20,9%	21,7%	25,0%
Slovakia	6,4%	12,9%	12,0%	11,5%	11,9%	16,9%	14,0%
Finland	29,2%	39,3%	39,0%	40,9%	41,2%	43,1%	38,0%
Sweden	38,7%	52,9%	53,3%	54,2%	54,7%	56,4%	49,0%

Source: own processing according Eurostat. *SHARES Summary results*. 2021. available on: https://ec.europa.eu/eurostat/documents/38154/4956088/SUMMARY-results-SHARES-2019.xlsx/4e5eb100-822c-ec50-cf04-803e6ef9ad05?t=1607706049587

Building a low-carbon society, a low-carbon economy, represents a huge challenge, especially the introduction of new technologies, but it also represents opportunities that bring new jobs, better competitiveness, economic growth, cleaner air, new technologies linked to electrification, digitalisation, smart solutions, secure energy supplies and the associated lower dependence on imports. According to studies, this is achievable and affordable. Investments in the low-carbon economy could create up to 1.5 million new green jobs by 2020 (EURÓPSKA KOMISIA. Prínosy opatrení v oblasti klímy.available on: https://ec.europa.eu/clima/citizens/benefits_sk)

Europe 2030 strategy

The Europe 2030 strategy builds on the EU's long-term goals for climate protection and builds on the previous 2020 climate and energy framework. The new climate and energy policy framework have set binding key targets for 2030 as follows [13]:

- A reduction of greenhouse gas emissions by at least 40%,
- ensure a 32% share of renewable energy in gross final energy consumption,
- increase energy efficiency by 32.5% compared to 1990.

The 2030 Strategy will enable the EU to reorient its economy towards a low-carbon one, which also correlates with the commitments under the 2015 Paris Agreement. Member States are therefore responsible for national measures to limit emissions from these sectors. Member States' contributions to overall emission reductions compared to 2005 range from 0% to 40% (see next chart, depending on their GDP per capita).

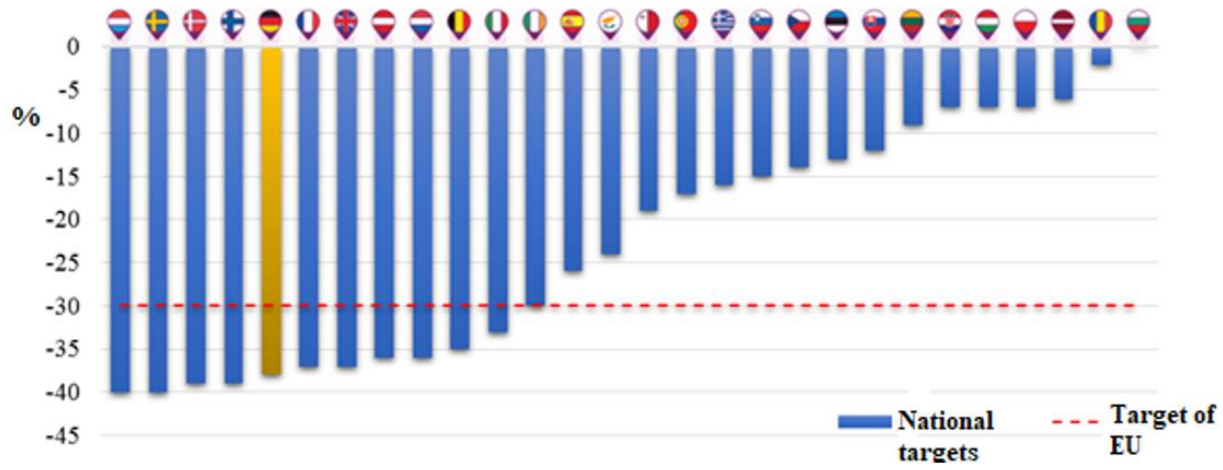


Chart 3: EU Member States' national emission of reduction targets for 2030 (%)

Source: own processing according https://eur-lex.europa.eu/legal-content/SK/TXT/HTML/?uri=CELEX:5201C0482&from=EN

It should be noted that within the EU more than half of CO2 emissions are produced by Germany and Poland, which follows from their coal reserves. On the other hand, the increasing emphasis placed on RES is making electricity production more expensive, with the result that security of supply is under threat.

2. Theoretical background of RES

Volker Quashing defines renewable energy sources as "sources that are the only reliable and environmentally friendly energy alternative in the long term". [15] Another source states that renewable energy comes from sources that are

naturally renewed and replenished. [16] According to Craddock, renewable energy sources represent a significant clean energy potential on a global scale, which could theoretically be used to meet the world's energy consumption. [17] The Slovak author Hronec states in his publication that renewable resources can be renewed indefinitely and thus used appropriately, using good management. Their characteristic feature is a supply which is not fixed, i.e. it can sometimes fall, sometimes rise. [18] As a very promising renewable energy source, they cite Dieter Seifried and Walter Witzel, that up to 7,000 times more energy than is currently consumed reaches the Earth every day. [19] The area that would be needed to provide the current global energy consumption is estimated at 700x700km, which is less than 500,000 square kilometres, if solar panels were placed in a suitable location, i.e. in the equatorial region where the sun's radiation is most intense. Solar architecture is currently used in many developed countries around the world. It is used in the reconstruction of old buildings as well as in the construction of new buildings. The basic factor in construction or renovation is the orientation of the windows, which should face south. The layout of habitable and non-habitable rooms in the building is also key. [20] The renewable energy sector is one of the quickest and rapidly transforming sectors of the global economy. It is bringing improvements in technology, falling costs, and the impact of new financing structures, and as well as is driving economic growth. The current 21st century is the age of renewable energy and its future development is predicted in the chart below.

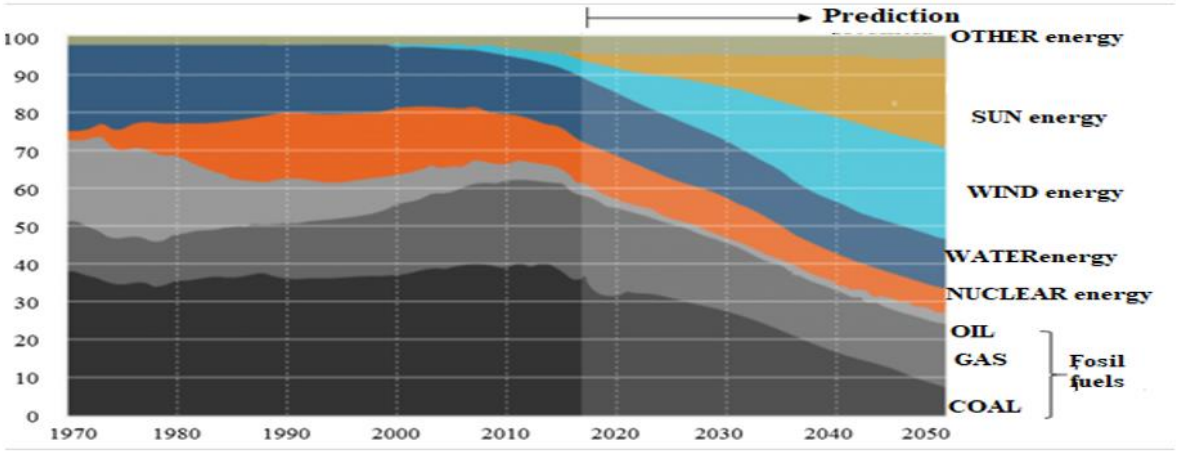


Chart 3: World energy mix in electricity generation by 2050 (%)

Source: Bloomberg New Energy Finance. Available on: https://worldview.stratfor.com/article/how-renewable-energy-will-change-geopolitics

The use of RES contributes to the reduction of CO2 emissions and thus helps to decrees the global warming. Daniel Scholten, a leading researcher at the Technical University of Delft in the Netherlands, says: "Renewable energies are practically universal. Few places in the world are without wind, sunlight, water and bioenergy of any kind. But compared to traditional fuels such as natural gas and coal, renewable energy has greater potential for decentralised production." [21]

3. Practical application of RES

In this part of paper, we present the results of our analysis - the use of renewables, focusing on selected V4 countries in terms of the share of renewables in gross electricity consumption in the V4 countries compared to the EU27 as well as in the transport sector. In the table below, we present the share of renewables in gross electricity consumption in the V4 countries compared to the EU27. In Slovakia, we can already see very positive progress in the use of RES since 2004. This has been due to an increase in the number of hydropower plants and in the total energy produced from water. In 2004, the Slovak Republic was only just

behind the EU27 average, i.e. (SK = 15.4% and EU = 15.9%). One of the main schemes to support the use of renewable energy sources is the feed-in tariff system. The scheme focuses on both generation and distribution of renewable energy and obliges distribution network operators to bring electricity from operators of feed-in tariff eligible installations to the market. In the Slovak Republic, a feed-in premium scheme is also established for the support of renewable energy sources and is enacted in Section 3 of Act No. 309/2009 (Act No. 309/2009 Coll., the Act on the Support of Renewable Energy Sources and High Efficiency Combined Generation and on Amendments and Additions to Certain Acts) Operators of all installations are entitled to a feed-in price or a premium, regardless of the RES in question.

Table 2 : Use of renewable in the electricity sector in the V4 countries and the EU 27

	2004	2007	2010	2013	2016	2019
CZ	3,7%	4,6%	7,5%	12,8%	13,6%	14,0%
SK	15,4%	16,5%	17,8%	20,8%	22,5%	21,9%
HU	2,2%	4,2%	7,1%	6,6%	7,3%	10,0%
PL	2,2%	3,5%	6,6%	10,7%	13,4%	14,4%
EÚ 27	15,9%	17,6%	21,3%	26,9%	30,2%	34,1%

Source: own processing according (according Table 1)

https://ec.europa.eu/eurostat/documents/38154/4956088/SUMMARY-results-SHARES-2019.xlsx/4e5eb100-822c-ec50-cf04-803e6ef9ad05?t=1607706049587

The Czech Republic and Poland also recorded positive developments.

In the Czech Republic, RES generated 878.9 ktoe worth of electricity in 2019. Compared to 2004, this value has increased more than fourfold, and

renewables now account for 14.05% of the total electricity generated. A major boom for photovoltaic energy (hereinafter PV) installations occurred in 2009 and 2010. Between 2009 and 2010, total capacity grew to almost 2 000 MW. Solar power has the potential to increase its capacity in the Czech Republic to 5,500 MW by 2030. Currently, PV installations are growing the fastest of all RES. In 2020, solar plants supplied 2 160 GWh to the nets. The Czech Republic does not provide ideal conditions for the use of hydropower it has 9 large hydropower plants with a capacity of 753 MW. Wind energy is only 6% represented in electricity production in the Czech Republic. ind power has the highest share of "green electricity" generation in Poland, supplying 15,151 GWh to the grid in 2020, up 57%. Solid biofuels were used in second place and hydropower is the third most used renewable source in electricity generation. Of the total electricity that was generated in 2019 from renewable sources, 9% came from hydropower, amounting to 200.5 ktoe. Solar energy is one of the less exploited renewable sources in Poland. In 2019, they produced electricity value 61.1 ktoe, that is only 3%.

In Hungary, only 9.99% of the electricity consumed comes from RES and this is the lowest share among the V4 countries. Of the total electricity consumption of 4 018.7 ktoe, only 401.5 ktoe comes from renewables. Compared to 2004 (2.2%), this share increased by more than 7%. Hungary has set a target of 13% of energy produced from renewable sources to final energy consumed. This target was already met in 2011, which meant 19,167.8 ktoe of final energy consumed came from 2,417.8 ktoe of renewable energy, which is 12.61%. Subsequently, Hungary became a negative example for the other V4 and EU countries, because after surpassing their target, they stopped further developing renewable energy sources and in 2019 they were 0.39% below their target. However, all 4 countries are below the EU27 average. As stated in Directive

2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable energy sources, one of the EU's important targets was a 10% share of biofuels in transport. In the table below includes not only biofuels, but also renewable -"green" electricity used in transport. In 2019, the overall share of renewables in transport is 8.9% and it is expected that this target will not be met by 2020. Major European cities have started to take steps to increase the share of "green" transport. If the EU decides to ban petrol and diesel cars, we expect the share of RES in transport to increase dramatically. (Strauss, Marine – Abnett, Kate.,2021) [22]

Table 3: Use of renewables in transport in the V4 countries and the EU 27

	2004	2007	2010	2013	2016	2019
CZ	1,2%	1,0%	5,2%	6,4%	6,5%	7,8%
SK	1,5%	4,0%	5,3%	6,2%	7,8%	8,3%
HU	1,0%	1,6%	6,2%	6,3%	7,8%	8,0%
PL	1,6%	1,7%	6,6%	6,7%	4,0%	6,1%
EÚ 27	1,6%	3,4%	5,5%	6,1%	7,2%	8,9%

Source: Own processing according https://ec.europa.eu/eurostat/documents/38154/4956088/SUMMARY-results-SHARES-2019.xlsx/4e5eb100-822c-ec50-cf04-803e6ef9ad05?t=1607706049587

In the Czech Republic, the main use of green energy in 2019 was in rail transport, followed by road transport. In 2019 the biofuels are also used in transport, which represents the share of RES use to the total energy consumed in transport is 7.8%. In Slovakia, electricity from renewable sources is mostly used in the rail transport sector, second place has road transport and then other types of

transport. These values have almost changed over the last 5 years. Biofuels used in transport account to 8.3% of the total energy consumed in transport.

Conclusion. From the above analysis we can set brief conclusions.

Hungary already met its target in 2013-2016. Hungary sets a negative example for European countries, as after having already surpassed its the target, has abandoned further development of renewables and in 2019 are just below the 13% level, so if they will improve they can still reach their target.

Poland is clearly the worst off among the V4 countries, as they are almost 3 percentage points below their target in 2019, this is mainly due to the overuse of coal.

The Czech Republic had planned to achieve 13% of its gross final energy consumption from renewable sources by 2020. In 2019 they were at 16.2%, so they have exceeded their target about 3,2% above planned and they are on right track for sustainability.

In Slovakia, the share of renewable energy to final energy consumption has changed significantly over the last few years. The heating and cooling sector has contributed significantly to this matter. Renewables already account for 16.9% of gross final consumption in 2019 and thus Slovakia met its 14% goal in advance.

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Biological sciences

ANTIVIRAL ACTIVITIES OF PLANTS FROM *TEUCRIUM* GENUS

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Abstract. *Pandemically spread and connected with wide variety of pathologies – the herpes simplex viruses are important pathogens in the human population. Their symptomatic can vary from asymptomatic to life-threatening conditions in newborns. With growing variety of resistant strains – the therapy of these infections became more and more problematic with every single day. Normally used in humanitarian medicine drugs as Acyclovir and its derivates are losing efficiency as viral resistance against them rise.*

Our research targets traditional medicine plants that can be screened for activity towards Herpes simplex virus type 1 and type 2. We have studied Teucrium chamaedrys L. and Teucrium montanum L. extracts from plants collected from several populations in Bulgaria. Previous studies of similar extracts showed promising results for their antiviral activity – both against replication of the

studied viral models inside host cells and against extracellular virions. Both species are used in traditional medicine of the region and are valuable source of biologically active substances.

Five extracts were included in the research. Two methanol thermostat extracts from T. montanum – each from two separate locations – Parvenets village and Fotinovo village. Three extracts have been used from T. chamaedrys – Methanol thermostat from Parvenets and water extracts from both locations.

In our study we have observed both activity towards virus replication inside the host cell and activity towards extracellular virus. This activity varied widely both between the studied plants and between populations. Most active was the Methanol extract from the population near Parvenets village with more than 50% replication inhibition of the Herpes simplex virus type 1 and 98% inactivation of the Herpes simplex virus type 2. Having activity against both viral replication and extracellular virions can suggest more than one active compound in the crude extract.

Even without strong antiviral effect – the results from this study have confirm previous results about the antiviral potential of plants from Teucrium genus. If molecular mechanism of this activity is uncovered then medicinal use can be achieved.

Keywords: *Herpes simplex virus, Teucrium montanum, Teucrium chamaedrys, Antiviral activity*

Introduction. Pandemically spread over all groups of veritable animals – the herpes viruses are important pathogen for both human and veterinary medicine. Subfamily alphaherpesviridae have two important pathogens in human population – Herpes simplex virus type 1 and type 2 (Human alphaherpesvirus 1 and 2 –

HHV-1 and HHV-2). Their symptoms can vary widely – from asymptomatic infections to life-threatening conditions in newborns. Both viruses can lead to lifelong latent infections [1].

Even without serious risk for the life of infected people, alphaherpesviruses can lead to serious compromising of the quality of life of the infected individuals [2]. Especially troublesome is that in nearly 80% of the cases it is observed that transmission is asymptomatic [3].

All of this results in widespread of these viruses and increases use of antiviral products. The main therapy of herpes HHV-1 and HHV-2 infections is use of nucleoside analogues such as Acyclovir and its derivates. This class of medicaments is used to block elongation of the newly synthesized DNA molecule and from there – formation of new viral progeny [4].

Serious shortcoming for this class of antivirals is that they depend on the viral thymidine kinase /TK/ enzyme and more often mutant viral TK enzymes can be observed or even TK negative viral strains [5]. This rise of antiviral resistance and multiple side effects of the existing ones determines the necessity of developing new products with activity against these viruses.

Phytoproducts and biologically active compounds contained in the plant extracts are potential source of new medicaments. They are usually very well tolerated by the human organism and often show lesser toxicity. Medicinal plants have had their place in illness treatment in human population for thousands of years and nowadays they have not lost their importance. As a consequence of total plant extracts containing more than one biologically active substance, they mimic the combination therapy with several synthetic preparations (the main approach to overcoming the emergence of drug resistance). Different extracts from medicinal plants have been proven to have antiviral activity in various studies [6,7,8]

Essential oils are one approach from the plants to react on the specific environmental conditions from temperature fluctuations to viral and bacterial infections. In traditional medicine their use can vary – from antioxidants to infection treatment agents. Different extracts containing essential oils have been proven to have antiviral activity, thus showing the potential of such products for humane use [8].

For maximization of plant potential – all extracts that are used should take into account the uneven distribution of active secondary plant metabolites in the different plant parts. When a drug is prepared from source material the correct separation should be made.

Effects of essential oils isolated from *Teucrium* species against various viruses indicates their potential for use in medicine for control or reduce of the burden of viral infection [8].

Teucrium montanum is a widely spread species from the *Laminacea family*. It has been found from 0 to 1900 altitude in many countries in central and southern Europe. Usually the plant grows in warm and dry mountainous regions [9]. Used for centuries in traditional medicine – it has been highly prized for its antibacterial and antifungal effects. Some anti-inflammatory and immunostimulant effects have been also observed [10].

There is some information on the activity of teucrium species against herpes viruses [7,11]. In a current study all extracts that have been tested are from two geographic locations – Parvenetz and Fotinovo village. All populations of both teucrium species – *T. chamaedrys* and *T. montanum* - have been growing on serpentinite soils. Soil composition is one of main factors that can affect the composition of secondary metabolites in the plant material. Usually such terrains are compromised with toxic concentration of heavy metals (mainly Ni and Cr) and

lower concentrations of Ca/Mg. Plants that grow on such locations have to adapt to the extreme conditions. Extracts from such source often demonstrate higher activity against pathogens [12,13,14] and higher concentration of biologically active compounds [15,16,17,18]

Materials and Methods

Study sites

For all studied populations voucher specimens were made and placed under unique number in the Herbarium of Sofia University.The localities of the plants sampled for all study populations and their abbreviations are presented in Table 1.

Plant material

The aboveground plant parts (including leaves, flowers and stems) of natural *T. montanum* populations during the flowering season from different localities in Bulgaria were collected. The air-dried and ground plant material was and used for extracts preparation.

Cells

MDBK (Madine and Darby bovine kidney) cell line, grown in Dulbecco's Modified Eagle Medium (DMEM) supplemented with 8% (growth medium) and 4% (maintenance medium) fetal calf serum (FCS) (with Gentamycin 8 μg/ml and 10 mM HEPES buffer), were used in the experiments.

Viruses

This study employed the F and BA strain of Human alphaherpesvirus type 1 and 2. The virus was propagated in MDBK cells and stored at −70°C until used.

Extracts

Two types of extracts were prepared from the plant material from each locality. The plant tissues from the aboveground plant parts (steams, leaves and

flowers) were cleaned, washed with double-distilled water, air-dried and then – ground. Plant material was used for preparation of methanol thermostatic extracts (MeT) and water extracts (W) [19] for all studies carried out in our research.

Cellular toxicity assay

The cytotoxicity was assessed by colorimetric MTT assay [20]. Confluent monolayers of the cell culture in 96-well plates were overlaid with 0.1 ml/well medium, 0.1 ml/well of dilutions of the extracts or 0.2 ml/well medium in the controls, and were incubated at 37◦C for 48 h. After 48 hours 0.020 ml of MTT (Sigma-Aldrich) – (5 mg/ml in PBS) was added to each well and after 2 h at 37◦C incubation optical densities (OD) were determined by plate reader at λ = 540 nm. The percentage of viable treated cells was calculated by the formula [(ODexp.)/(ODcell control)] × 100, where (ODexp.) and (ODcell control) indicate the absorbencies of the test sample and the cell control, respectively. The 50% cyto-toxicity concentration (CC_{50}) was calculated by regression analysis of the dose – response curves generated from the data. MTC (maximum tolerated concentration) was determined microscopically on the 48th hour.

HHV-2 replication inhibition

In the experiments, the survival of HHV-2-infected and substance-treated cells was determined by colorimetric MTT assay [20]. Modification of the assay developed for screening of anti-HHV extracts by Takeuchi et al. (1991) [21] was used. As a reference substance we used acyclovir (ACV) (Sigma-Aldrich) diluted in DMSO and maintenance medium ex tempore. Confluent monolayers in 96-well plates were overlaid with 0.1 ml/well of virus suspension – MOI = 150 $CCID_{50}$/well. The plates were incubated for 1 h at 37 ◦C and dilutions of the extracts or maintenance medium (for virus control) were added. Uninoculated cells were used for cell control. The percentage of protection was calculated by the

formula [(ODexp.) – (ODvirus control)/(ODcell control) – (ODvirus control)]*100, where (ODexp.), (ODvirus control), and (ODcell control) indicate the absorbencies of the test sample, the virus control and the cell control, respectively. The 50% effective concentration (EC_{50}) was calculated by regression analysis of the dose – response curves generated from the data.

Virucidal activity

The effect was tested by direct contact assay. Undiluted stock virus suspensions were treated with equal volumes of the compounds in MTC, prepared in medium. After incubation at 37 ◦C for 5′, 15′, 30′, 60′, 120′, 240′ and 360′ the control and the treated viruses were frozen, and the difference in the biological activities between them was determined on the base of infectivity. The surviving infectious virus titers were determined in CPE assay using the method of Reed and Muench [22].

Activity against viral adsorption

Equal volumes of viral stock containing 10^5 $CCID_{50}$/ml and media with MTC of the appropriate extract and viral control of equal volumes of viral stock virus and media were applied on confluent cell monolayers for 15′, 30′, 45′, 60′ and 120 min. After every time interval the medium with the virus was removed and the monolayer was washed three times. At the 24th hour, all samples and controls were frozen and titrated by the determined CPE assay using the method of Reed and Muench [22].

Results and Discussion

Cytotoxicity assay

In current study five extracts have been tested for their activity against viruses in cell cultures. As a necessary first step – a toxicity of the extract against used cell culture have been determined. Microscopically observed MTC (Table 1)

and using MTT assay - ratio between live and apoptotic cells have been applied determining valuable information about non-toxic concentrations which can be used in the following experimental assays. Building toxicity curves the cytotoxic concentration 50% (CC_{50}) have been determined for every extract (Figure 1 and Figure 2).

Table 1. Types of extracts and cytotoxicity characteristics

Extract	Plant	Location	Extraction	MTC [mg/ml]	CC_{50} [mg/ml]
MeTF	*T. montanum*	Fotinovo village	Metanol	1	2,46
MeTP	*T. montanum*	Parvenets village	Metanol	2	3,27
WFTC	*T. chamaedrys*	Fotinovo village	Water	3	6,21
MeTPTC	*T. chamaedrys*	Parvenets village	Metanol	1	1,92
WPTC	*T. chamaedrys*	Parvenets village	Water	3	5,93

With both T. *montanum* and *T. chamaedrys* extracts – higher toxicity is observed with those prepared from plants collected near Fotinovo village. This clearly states that there is some difference in the composition of the secondary metabolites based on the specific areal.

Both water extracts are much less toxic than methanol ones. The values for both MTC and CC_{50} are in range similar to those previously determent for *T. chamaedrys* extracts [7].

The hierarchical ladder based on MTC looks like this (from lower to higher cytotoxicity):

MeTF= MeTPTC<MetP<WFTC=WFTP

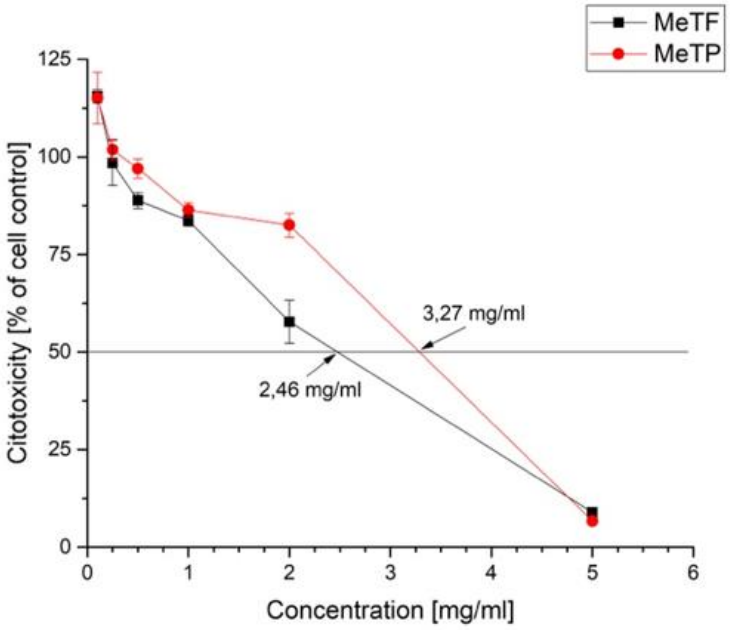

Figure 1. Cytotoxicity of *T. montanum* extracts towards cell line MDBK

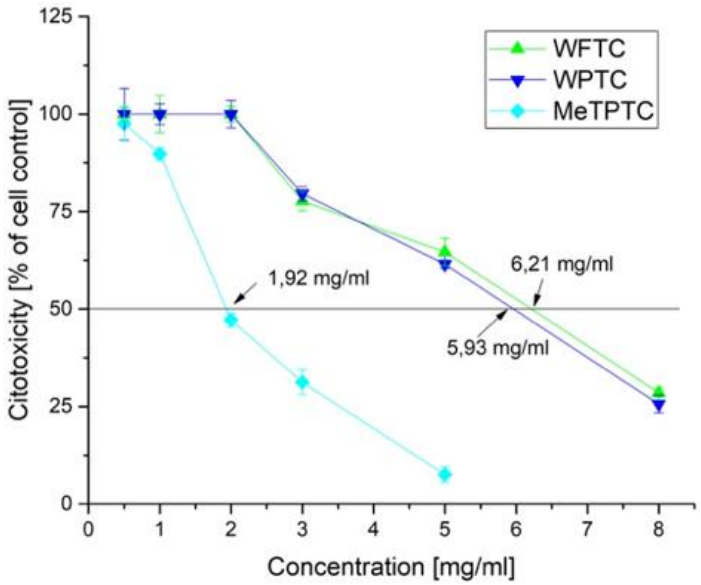

Figure 2. Cytotoxicity of *T. chamaedrys* extracts towards cell line MDBK

With CC_{50} 1,7 mg/ml and MTC of 1 mg/ml the MeTPTC is the most toxic extract from the five included in current study. This step in the research is

important is it limit the concentrations that can be used in the subsequent experimental assays.

Antiviral activity

All five extracts have been used up to their MTC dose against replication of both HHV-1 and HHV-2 model strains. Dose-dependent inhibition was observed with peak activity up to 55% against HHV-1 (Figure3) and 49% against HHV-2 (Figure 5) for the extracts of *T. montanum*. *T. chamaedys* extracts have weaker activity against both viral models without reaching inhibition concentration 50% (IC_{50}).

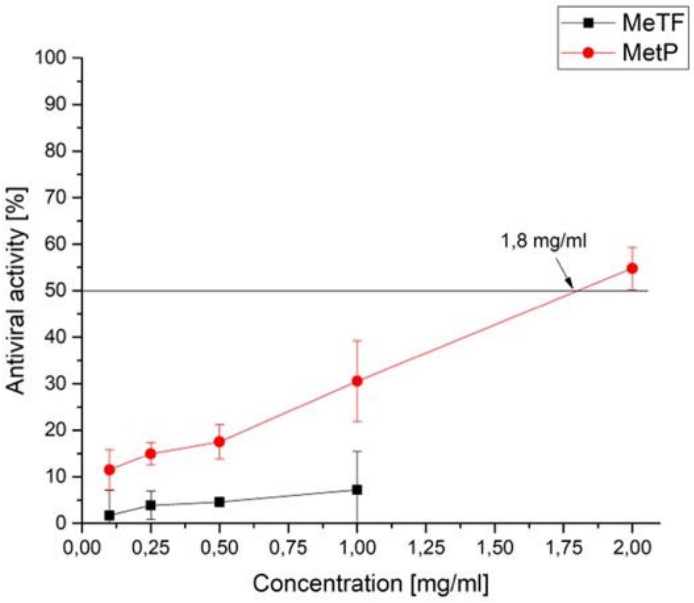

Figure 3. Antiviral activity of extracts against HHV-1

Most potent activity have been shown from the MeTP extract wich is only one for which can be determined IC_{50} value – 1,9 mg/ml. Selective index (SI) can be calculated only for him – 1,72 against the replication of HHV-1. This value is much lower than corresponding one for the standard therapy for HHV-1 infections

– Acyclovir (with SI around 560). Nevertheless, this value is normal for such type of total extracts and correspond with similar studies [7,23].

In MTC extracts from *T. chamaedrys* have reached respectively 41,83% (WPTC), 37,23% (WFTC) and 26,78% (METPTC) against HHV-1.

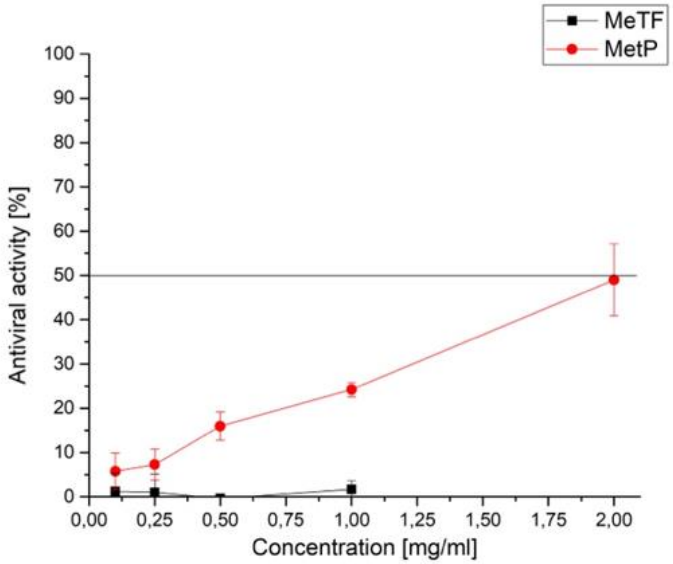

Figure 4. Antiviral activity of extracts against HHV-2

For all the studied extracts – activity against HHV-2 model viral strains was similar or lower, again – with most active one – MeTP with 49% inhibition of viral replication when administrated in MTC. *T. chamaedrys* extracts again exhibited lower activity than those from *T. montanum* with 33,3 (WFTC), 30,43 (WPTC) and 21,9% (METPTC).

Virucidal activity

With MeTP was determined most active against both viral models – only *T. montanum* extracts have been used in subsequent study for virucidal activity. Against both viral models – activity was weak. Most potent effect was observed from MeTP extract against HHV-2 with over 1,5 log of lowering the viral titter. This corresponds to 97% inactivation.

These results are much weaker compared to our previous study with similar extracts from plant from Teucrium genus [7].

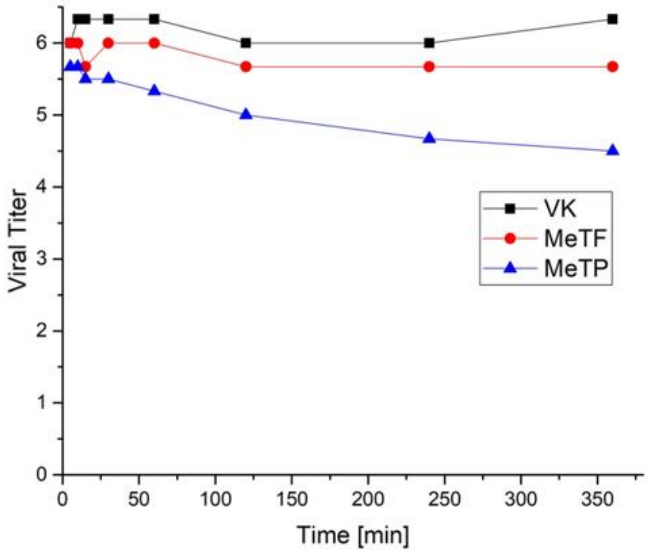

Figure 5. Virucidal activity of extracts against HHV-2

Conclusions. The pandemic of labial and genital herpes is still a significant problem, mostly because of the rise of antiviral resistance and multiple side effects of the existing substances used in medical practice. In the present study, which is a continuation of our previous work with species of the genus *Teucrium*, we monitor the activity of 2 water and 3 methanol extracts of two plant species of the same genus against the etiological agents that cause labial and genital herpes. Although water extracts are almost 2 to 3 times less toxic than methanol ones, they do not show any antiherpes virus activity. The most active was methanol thermostatic extract from *T. montanum*. For the latter, an effect on extracellular virions has also been found, although these results are much weaker compared to our previous study with similar extracts from plant from Teucrium genus [7].

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Economic sciences

THE EFFECT OF MATHEMATICAL SKILLS ON THE LEVEL OF FINANCIAL LITERACY OF HIGH SCHOOL STUDENTS IN ISRAEL

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Abstract. *This study contributes to an understanding of the level of financial literacy of high school students in Israel between the ages of 18 and 15 and to the cognitive and non-cognitive factors that may influence students' financial knowledge, attitudes and economic behavior*.

Many studies claim that low cognitive levels that are measured and expressed in mathematical skills, constitute a barrier and difficulty for the student to access information, prioritize alternatives correctly and avoid biases such as aversion to risk.

The OECD states that it is committed to performing basic mathematical calculations and solving simple computational problems are critical skills and have great importance on financial literacy. If a manufacturer's mathematical skills improve, there may be charges for their knowledge and economic behavior so that they will operate in an informed and different manner.

Findings from other studies suggest that the higher the mathematical knowledge, the greater the tendency of the person to accumulate property and financial assets.

Higher mathematical education increases the chance of utilizing more reliable and solitary credit, and reduces the risk of accumulating large and simple debts.

In my research, it can be seen that students in Israel have difficulty solving questions that require basic mathematical knowledge and skills and this has an impact on their level of financial literacy. One of the conclusions of my research is that in order for financial education programs in school to be effective and achieve their goals, the curriculum must include learning and reference to impart basic arithmetic and mathematical knowledge and skills to students.

Keywords: *personal finance, financial literacy in Israel, Mathematical skills, financial education programs.*

Introduction. The impact of crises and changes in the financial markets on households and the well-being of individuals has increased the fear of many countries that their citizens do not have the knowledge, tools and skills required to make informed economic and financial decisions. [15, p.17; 19, p.18]

Many countries have begun to grasp that their citizens have a duty to show personal responsibility for their financial future, but for this reason, the state has the duty to provide them with the basic knowledge and skills necessary to conduct and make informed financial decisions.

According to the International Financial Education Network (INFE, 2009 ,(the lack of financial literacy was one of the factors that contributed to unsubstantiated financial decisions which, in the future, may have indirect negative consequences. There is also widespread recognition of financial literacy as a necessary life skill, and an important element in economic and financial stability and development in these areas. [24, p.19]

Various factors influence the level of financial literacy observed among people. For example, financial literacy is influenced by information and skills in additional areas such as invoicing skills. A certain level of mathematical literacy is considered a necessary condition for financial literacy. Huston [17, p.18] argues that if a person has difficulty with arithmetic skills, this will certainly affect his financial literacy, as well as skills and knowledge such as reading and vocabulary essential to a particular level of financial literacy. as expected, mathematical knowledge affects the ability to measure quantitatively and numerically. [24, p.19]

In a survey conducted by the OECD between September 2010 and early November 2010, 12 countries were included and about 1,000 respondents aged 18 and over participated. Participating countries: Armenia, Czech Republic, Estonia, Germany, Hungary, Ireland, Malaysia, Peru, Poland, UK, South Africa and Norway. The aim of the study was to make a comparison on the issue of financial literacy, in the areas of financial knowledge and skills, economic behavior and financial attitudes of the various respondents, between the 12 countries and within the countries. The purpose of the measurement and evaluation performed using questionnaires is to understand the gaps that exist in the respondents' knowledge, behavior and attitudes regarding the conduct of personal financing. The knowledge questions in the survey were based on the 3 famous questions designed by Lusardi and Mitchell called "the big 3" and they deal with the compound interest rate, inflation and risk diversification. The questions about behavior and financial attitudes dealt with everyday issues of money management, budget management, self-discipline in dealing with money, familiarity with financial products and financial planning in the short and long term. [4, p.16]

As part of the Health and Retirement Research (HRS) conducted among Americans aged 50+, the researchers, Lusardi & Mitchell 2004 designed a

retirement planning module to assess respondents' financial literacy levels, addressing their ability to manage budgets, make basic mathematical and financial calculations and save for retirement. To this end, the researchers formulated 3 guiding questions that were dubbed "the big 3". The questions dealt with the calculation of compound interest, inflation and risk management.

Here are the 3 questions as formulated and presented in a 2004 Lusardi & Mitchell study:

1. Suppose you had $100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow: more than $102, exactly $102, less than $102"?

2. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, would you be able to buy more than, exactly the same as, or less than today with the money in this account?

3. Do you think that the following statement is true or false? “Buying a single company stock usually provides a safer return than a stock mutual fund”.

The findings show that only half of the respondents correctly answered the first, relatively simple questions that related to compound interest calculation and inflation.

Only a third answered all 3 questions correctly. The conclusion is that the level of financial literacy among older Americans is low.

These findings are not typical of the US alone, and it can be seen that even in the UK, many borrowers have difficulty understanding basic products such as mortgages and the various interest rates the bank offers them in this regard. [22, p.18]

Review In further studies around the world, Lusardi & Mitchell [18, p.18] conclude that the level of financial literacy is low not only in the US but also in

other countries with sophisticated and developed financial markets such as Germany, the Netherlands, Switzerland, Sweden, Japan, Italy, France, Australia and New Zealand.

Analysis of the findings shows that people who received high scores in math and science also received higher scores on numerical questions.

The achievements of the youth in Israel in financial literacy from an international perspective and from an intra-Israeli perspective

Israel's average score on financial literacy in the 2012 PISA study is 476 points, and this average score is 24 points lower than the average of the 13 participating OECD countries. Israel ranks 14th out of 17 participating countries. Countries with an average score that is not significantly different from that of Israel are: USA, Russia, France, Slovenia, Spain, Croatia, Slovakia, and Italy.

Demographic characteristics and cognitive and non-cognitive factors that influence the economic behavior of individuals and households - Financial literacy may contribute to positive financial behavior, but it is also possible that consumers will acquire financial knowledge and manage their money effectively, when factors such as family, experience and socialization of economics will have a positive effect on their knowledge and attitudes and ultimately on people's financial behavior. [16, p.17]

Financial behaviors are influenced by a lot of psychological biases, so when planning financial education programs, the context of the state, standard of living, average consumer spending, credit availability, exposure of households and individuals to financial advisors and experts, math skills and basic numbers should be taken into account. Equally important and perhaps even more so, in the opinion of some researchers, are the non-cognitive, psychological and emotional factors that influence in a way that is not always rational and informed in the decision-

making process of people. Variables such as: risk aversion, self-confidence, se lf-efficacy, faith, ability to make decisions under conditions of uncertainty and more. Understanding and treating these factors as influencing the economic behavior of individuals may improve the economic well-being of the individual and of the state. [2, p.16]

The relationship between mathematical and arithmetic skills and the level of financial literacy - Since 2012, the OECD has decided to introduce another test in the field of financial literacy, which will examine the relationship between students' level of mathematical skills and their level of financial literacy. The literature argues that these skills, have the power to stimulate logical thinking, are capable of solving complex problems and have a positive impact on long-term planning. [26, p.19]

A study conducted in Mexico City, among high school students aged 18-15, examined their level of financial literacy, and the degree of connection and impact of mathematical and numerical skills on their level of financial literacy. The results show that the level of students' financial literacy is low. Also, mathematical skills have a positive effect on financial literacy. The relationship between mathematical cognitive abilities and financial literacy is significant and positive. [28, p.19]

The OECD [23, p.18] states that the ability to perform basic mathematical calculations and solve simple computational problems are critical skills and have an important impact on financial literacy. If students' mathematical skills improve, it may have a positive effect on their knowledge and financial behavior, so that they will act in an informed and responsible manner.

Findings from other studies suggest that the higher the mathematical knowledge, the greater a person's tendency to accumulate property and acquire financial assets. [9, p.17]

Mathematical knowledge has a positive effect on an individual's chances of acquiring shares in the capital market. [21, p.18; 7, p.16]

Higher mathematical education increases the chance of taking advantage of more reliable and cheaper credit, and reduces the risk of accumulating large debts and going bankrupt. [8, p.16]

Agarwal and Mazumder [1, p.16] found that low mathematical abilities increase the probability of making costly financial mistakes.

Emphasis in the study was placed on cognitive aspects such as numerical abilities, cognitive reflection, deliberation, and emotional factors such as financial anxiety, self-confidence, and math anxiety. These variables have been shown to have a major impact on the decision-making process of individuals in further studies [13, p.17].

These variables actually affect an individual's belief in his or her ability to cope with complex and challenging tasks throughout life, and perform them well without fear and without fear of failure. [5, p.16; 6, p.16]

Math anxiety leads to poor mathematical performance and has lifelong indirect negative effects on the acquisition of education and the decision-making process related to an individual’s career. [3, p.16]

Recent studies link anxiety in mathematics to performing basic number processing and simple tasks such as counting items [12, p.17; 20, p.18]

The affinity for numbers and the ability to understand and use numbers affects the ability to deal with and manage money, and therefore it has a crucial impact on an individual’s financial literacy. The difficulty and anxiety of numbers and mathematics impair the individual's ability to perform simple numerical calculations at work or during his economic life. One of the conclusions in this context that emerges from the study of Cole et al [10, p.17], is that the high school

curriculum should in clude more math training and the improvement of basic numerical and mathematical skills that have the potential to positively impact an individual's financial literacy level and financial outcomes.

The most effective way is to equip students already in elementary school with math skills, while improving their negative emotions and concerns, which prevent or delay their coping with making financial matters. [10, p.17; 11, p.17]

Given previous studies and meta-analyzes that showed that intervention in schools and financial education programs are not necessarily effective and do not improve financial behavior, the opinion in this study is that resources should be directed to improving mathematical knowledge, understanding numbers and being able to deal with mathematical issues without fear. It can be seen that math anxiety prevents young people from actively participating in activities that require arithmetic skills. Also, in order to answer questions that deal with calculating simple interest, compound interest and inflation, basic mathematical skills and knowledge are required, which will then also improve the level of financial literacy of individuals and also contribute to the improvement of economic well-being. [27, p.19]

A large study based on U.S. censuses and households examined whether financial literacy and cognitive abilities had a positive impact on the quality of financial decision-making. In fact, the study seeks to answer the question of whether personal finance and math courses at the school provide adequate tools for graduates to achieve good financial results, accumulate assets and not be burdened with debts and loans early in life. The findings of the study suggest that further training in mathematics may lead to greater participation in the financial market, an increase in investment income and better credit management, including fewer fines and foreclosures. [10, p.17]

Other researchers suggest the position that many people make suboptimal financial decisions because they do not understand the costs and benefits of the choices they face. The fact is that the financial results can be changed by training in mathematics and improving the mathematical knowledge. Guidance that will influence informed financial behaviors, from signing a cost-effective and efficient mortgage contract with the bank to purchasing an investment product with a handsome return or attractive and effective insurance that will protect the customer in an unforeseen event. [14, p.17]

Sample method - The potential population for the current study to which a request was sent to volunteer and participate in the study, with the help of Facebook supervisors, included about 37,000 students. Of these, 618 filled out the questionnaire as required. The sampling method was probabilistic: random. The study participants were located via the Internet, according to a protected segmentation via the social network, Facebook, when it was possible to define the specific criteria of the youth to whom the questionnaires would be sent: gender, age, and country of residence. The relevant criteria in my study were: Boys and girls aged 15 to 18 living throughout the State of Israel. In addition, I determined the duration of the distribution of the questionnaire and receive data in real time.

Research tools: questionnaire - The research tool I used to collect findings is questionnaires and their distribution through the social network according to criteria and segmentation pre-selected by the research editor.

The questionnaire I built consists of a wide range of questions as expressed in many articles and studies around the world. The questions were asked to adults and young people and were tested as highly effective in many studies.

The choice of research variables was based on metrics that have appeared in the literature with respect to different aspects of the content worlds surrounding the research topic: financial literacy.

The OECD wishes to assess the field of financial literacy takes into account 3 different perspectives: the content, processes and contexts relevant to the assessment. [25, p.19]

The questionnaire in the present study measures and describes the level of financial literacy among high school students in Israel, and includes 3 main dependent variables: financial attitudes, economic behavior, and financial knowledge and skills, and independent variables: demographics (gender, age, grade, place of residence, socioeconomic level, Level of religiosity), participation in a financial education class, employed at work and receiving pocket money.

The questions themselves are related to a variety of financial content worlds such as: loans, investments, savings, insurance, accounting and mathematical capabilities, and accounting.

General structure of the questionnaire (Appendix 1) - The questionnaire consists of 4 chapters: Part 1: Attitudes in the field of finance, consists of 17 topics that require the student's reference. Part 2: Behaviors in the financial field, consists of 12 statements. Part 3: Financial Knowledge, consists of 8 questions, with 7 questions being American and one question right / wrong. Part 4: General and Demographic Questions, consists of 9 questions.

Findings:

Table 1: Attitudes, Behavior & Financial Knowledge

Descriptive Statistics

	N	Mean	Std. Deviation
Attitudes: Long-term planning	617	4.1475	.53181
Attitudes: Confidence and self-belief	612	3.7549	1.00672
Attitudes: Financial maturity	616	4.2581	0.85915
Attitudes: Resistance to risk	606	3.4736	1.1216
Attitudes: Overall Score (In Questionnaire: Part I, Table 1)	617	4.0288	.45340
Attitudes: Consultation with professionals	615	3.6057	.75353
Attitudes: Consultation not with professionals	615	2.3725	.64076
Attitudes: Consultation with family members	615	3.6244	1.00991
Attitudes: Not consulting	613	2.3458	1.10160
Behavior: Negotiate and compare prices	607	3.6351	.84326
Behavior: Financial responsibility	607	3.9130	.65033
Behavior: Involvement in household management	604	2.8079	1.15880
Behavior: General Score (Scale 1 - 5)	618	3.6286	.69946
Behavior: Overall Score (Percent Scale)	618	65.2289	20.89559
Financial Knowledge: Question # 1	599	70.28	45.739
Financial Knowledge: Question # 2	591	39.26	48.873

Financial Knowledge: Question # 3	586	41.30	49.279
Financial Knowledge: Question # 4	583	62.61	48.426
Financial Knowledge: Question # 5	589	80.48	39.673
Financial Knowledge: Question # 6	588	13.95	34.672
Financial Knowledge: Question # 7	585	12.14	32.683
Financial Knowledge: Question # 8	588	87.1	18.775
Financial Knowledge: General Score	606	50.75	21.968
Valid N (listwise)	560		

Attitudes - An analysis of the findings in the questionnaire, in the chapter dealing with students' attitudes about financial issues, reveals that in the overall attitude variable, the average score of 617 of the respondents is 4.0288 out of 5 and the standard deviation score is 0.45.

This figure indicates that on average, most students have very positive financial attitudes and tend to adopt approaches that advocate long-term planning, with self-confidence and the ability to understand and deal with the consequences of financial risk.

Behavior - In analyzing the findings in the questionnaire, in the chapter dealing with the financial behavior of high school students, we calculated the variable: general behavior in two different ways. First, we calculated the variable Behavior: general score (scale 1 – 5) and the mean score obtained 3.6286 and a standard deviation of 0.69.

This score may reflect, among respondents, a moderate level of effective financial behavior, with respect to students' ability to negotiate and compare prices, act financially responsibly, and be involved in decisions related to household

management. I will note that all the mean scores obtained in the sub-variables of behavior, are lower than 4.

It is possible that in the second method of calculation, the variable, Behavior: overall score (percent scale) is more accurately reflects the economic behavior of students in daily life. The average score obtained is 65.22 and the standard deviation is 20.89.

These findings indicate a low average level of effective and responsible financial behavior among students.

Financial knowledge and skills - An analysis of the findings in the questionnaire, in the chapter dealing with the students 'financial knowledge, shows that the overall average score in the students' financial knowledge is very low, 50.75 with a high standard deviation of 21.96.

This figure generally indicates a very low level of financial knowledge and in addition, there are students with very disturbingly low grades, which may indicate a lack of knowledge and basic financial, arithmetic and cognitive skills.

Scattering the average scores within the questions in the chapter dealing with financial knowledge indicates the complex coping of high school students with different difficulty levels of the questions.

In the fourth question, which tests students' basic math skills, and deals with calculating percentages, only 62.61 percent of students answered correctly.

This percentage is relatively low and has a negative impact on students' level of financial literacy.

The fifth question, like the previous one, requires more basic mathematical skills and an understanding of simple arithmetic operations in order to compare the possibilities presented in the question. 80.48 percent of the students answered correctly to this question which is considered relatively easy.

Conclusions. An analysis of the findings of the survey I conducted reveals that the level of financial literacy of high school students in Israel is generally low. The scores obtained in the knowledge variables and attitudes and economic behavior are low and unsatisfactory.

In questions that require basic mathematical skills such as calculating percentages and basic arithmetic operations, the scores obtained were relatively low and disappointing.

The low grades may indicate a lack of basic skills, mathematical, financial and cognitive that make it difficult for students to answer questions that deal with finance.

Several studies around the world suggest that math anxiety and low performance in basic math operations negatively affect a student's ability to deal with complex financial questions and issues.

The conclusion for educators and policy makers is that there is a need to build a curriculum for financial education that will include all the factors that may positively influence financial knowledge and the attitudes and economic behavior of students. Undoubtedly, one of the important factors to include in the curriculum is to impart basic arithmetic and mathematical knowledge and skills that will help students deal with complex financial questions and problems that require basic mathematical calculations.

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APPENDIX

1. ***** Questionnaire *****

Greetings,

The questionnaire before you are about money. In the present study we want to examine the attitudes and knowledge of young people in their field of finance and management. The study will assist us in a thorough understanding and policy setting in the field of the financial world among young people in Israel.

Thank you for filling out the questionnaire seriously for understanding and determining financial education policy among young people in Israel. The questionnaire is anonymous and its findings are analyzed exclusively.

Thank you very much, the research team.

Part I: attitudes in the field of finance

Here are various statements in the field of money management Indicate to what extent you agree with these sentences:

The sayings	Very much	Strongly agree	Moderately agree	Slightly	Very Slightly
It's better to spend the money today than to save it in the long run.					
It's better to live in the moment, here and now, and not think how to make money tomorrow.					
In order to achieve personal goals that depend on money, it is advisable to plan for the long term.					
It is advisable to plan ahead in order to achieve money-raising goals.					
One can always find a solution to such and other problems to achieve the goals that one sets for himself.					
In order for a person to buy products that they need in the future, they need to avoid buying certain products today.					

One should take into account that any opportunity for financial investment and high profit also contains a great risk of loss.					
The likelihood of an investment loss is reduced as it is dispersed in various investment channels.					

Here are some of the factors that people consult with about financial matters. For each factor, indicate to what extent it is advisable to consult him (in terms of reliability, professionalism, etc.) in the financial fields:

The consultative factor	**Very much**	**Strongly agree**	**Moderately agree**	**Slightly**	**Very Slightly**
A bank teller					
Websites on the Internet					
Friends who understand money					
Family members					
Financial Advisor Specialist					
Professional teacher / educator					
Communication Factors					
Financial education teacher.					
No need to consult, it's a personal decision					

Part Two: Financial Behaviors

Each of us has different financial behaviors. Mark what are the behaviors that characterize you.

1. Here are two tactics that some people take when they want to purchase a particular product. To what extent does each of these tactics characterize your purchasing process?

	Very much	**Strongly agree**	**Moderately agree**	**Slightly**	**Very Slightly**
Negotiate and debate the terms offered to me.					
Compare prices between different products from the same field.					

2. Who do you consult with before purchasing any product and who makes the decision? (More than one answer can be marked)

A. I consult with friends or family but I make the decision.

B. I consult with an expert in the field, but I make the decision.

C. I consult with friends or family and they also make the decision.

D. I consult with an expert in the field and he also makes the decision.

E. I do not consult with others at all, only make the decision independently.

F. None of these.

3. Mark each of the following statements as the correct answer for you.

	Always true	Generally true	Sometimes true	Usually wrong	Always wrong
Before making a purchase, I consider whether I can afford to purchase the product financially.					
I make sure to pay my bills on time					
I keep a close eye on my financial affairs very often					
I set myself long-term financial goals (save money for school, business, higher education) and strive to achieve it					
I share some of the financial decisions that occur daily in my family					
I and / or my family are running according to an orderly income budget and expenses					

I usually check to see if my monthly expenses are right for my needs and financial capabilities					
Over the past year I have been able to save money as I had planned					
If my monthly income does not allow me to purchase a particular product, I request a loan from my family or bank					

Part 3: Knowledge of the Financial Domain

What are the correct answers in the following financial areas? (If you don't know, mark "don't know")

1. Suppose you have $ 100 in a bank savings plan, and the annual savings rate is 2%. 5 years later, how much money will be saved in the savings plan?

A. More than $ 102

B. Exactly $ 102

C. Less than $ 102

D. Do not know

2. Suppose the annual interest rate in your savings plan is 1% and the annual inflation rate is 2%. after one year, how much would you be able to buy with the money in this account, compared to today?

A. More than today

B. Just like today

C. Less than today

D. don't know

3. The monthly repayment of a mortgage for a period of 15 years is higher than the monthly repayment of a mortgage for 30 years, but the total interest paid to the bank in the mortgage for 15 years is lower than the 30-year mortgage.

A. Right

B. Wrong, it's the same refund.

C. False, is a lower refund.

D. don't know.

4. The school has 200 children, 20% of them girls and 80% of them boys. 40% of girls have black hair. How many girls in school don't have black hair?

A. 16

B. 20

C. 24

D. 40

5. Check the cheaper option of buying tomatoes:

A. Buy a pound of tomatoes for $ 2.75

B. Buying a whole 10-pound box at $ 28.

C. The same

D. don't know

6. What do you think of the following: Buying a single stock usually gives a more sure return than a mutual fund purchase?

A. Right

B. Not true

C. Can't know

D. Do not know

7. What is likely to happen to bond prices if the interest rate in the economy rises?

A. Go up

B. Got down

C. They will not change

D. Do not know

8. Amir has an account at one of the banks in Israel. He recently received an email with the following content:

"Dear Customer, there was a malfunction on the bank website web server. All of your personal access to the bank account on the site has been deleted. As a result, you do not currently have access to your bank account through the bank website. It is important to note that in this situation, your account is not secure. To access your account through the Bank's website, please click on the link below. You are also requested to provide the Internet access information to your bank account, welcome, the bank "

Which of the following tips would you define as good advice and which advice?

Possible advice	Good advice	Bad advice
Reply to this email and provide it with your bank account login information online.		
Contact your bank clerk and check the e-mail verifications sent to you.		
If the attachment is the same as the bank's URL, then click on the link and follow the instructions and if not, don't click.		

Part 4: General and demographic questions

1.What's your gender? A. male B. Female

2. What is your age? _____ years

3.What is the last class you completed in school?

4. Did you learn a lesson in "financial education" within the school? A. Yes B. No

5. The name of the locality you live in? _____

6. What is your nationality? A. Jew b. Arab c. Other: _____

7. What is your degree of religiosity? A. Religious b. Traditional c. Secular

8. Do you work? A. Yes B. No

9.Do you receive monthly pocket money from your parents? A. Yes B. No

You have successfully completed the questionnaire.

Thank you very much for your cooperation.

The research teams.

Sociological sciences

REASONS OF HOMELESSNESS IN SLOVAKIA IN SOCIAL WORK PERSPECTIVE

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Abstract. *The presented article deals more deeply with the phenomenon of homelessness, identifies it as homeless people. It addresses poverty as a common cause of homelessness. It is considered a social problem and is a very specific phenomenon. The empirical part contains research on the typical socio-pathological effect, which led the respondents to home loss. The respondents were homeless people who slept in a shelter for homeless people in Rožňava, a town located in the eastern part of the Slovak Republic. We implemented a questionnaire, which was attended by 20 respondents, ie the homeless. We analyzed their age, education, family members and the reasons that led them to this condition. The causes were found to be different, but when they found out, neither of them expected such a fate and loss of living space. There are no major differences between the primary and secondary causes of homelessness. The result*

of the research shows as the main cause of homelessness basic everyday life situations, certainly not extremely unexpected situations. Poverty, long-term unemployment, mental disorders, and various types of addictions most often caused them to lose their homes. The importance of homelessness prevention and recognizing the risk causes of homelessness are essential skills of a social worker. At the same time, field social work is very important, where field social workers are most successful in working with the homeless and helping them to survive the day, or to get out of the current unfavorable situation and re-enter the labor market, integrate into society or re-establish family relationships and live a quality full life. They are also able to recognize the threat of home loss in time, and preventive activities can prevent this social phenomenon. It is very important for those at risk to be aware that they can seek the help of social workers and other social institutions, which will provide them with self-help assistance and will not lead to complete exclusion and street life. Another big problem is that the homeless are often socially maladapted, and the barrier is that they do not know their rights and opportunities, and because of this they are unable to solve their problems on their own. This complex phenomenon has been present in our society for centuries and the cause of homelessness has remained the same - poverty.

Keywords: *homelessness, poverty, unemployment, addiction, mental disorders, prevention, social work.*

Introduction. The aim of our article is to point out that the causes that lead to homelessness are so common that they can meet everyone and do not only threaten a certain section of the population. In doing so, we want to emphasize the importance of prevention on how to prevent homelessness. It is much more

difficult for social workers to get a client to have their own home again and to integrate into society, than to prevent their clients from losing their homes.

There are many theories to define "homelessness" and explain this socio-pathological phenomenon in various ways, but all theories agree that the main attribute is that a citizen who does not have shelter overhead does not have their own privacy. In extreme cases, a citizen is forced to live on the streets even though he or she has the right to services, which are mostly provided by non-profit social services organizations. Everyone has the right to housing. This is also enshrined in the Universal Declaration of Human Rights, which is one of the basic UN declarations. Article 25 states: "Everyone has the right to a standard of living adequate for the health and well-being of his or her family, including food, clothing, housing, medical care and necessary social services. illness, incapacity for work, widowhood, old age or otherwise“ [1].

Losing a home can sometimes be a multi-year process during which a person has to overcome life events that are not considered common to the everyday problems of other citizens. Along the way that leads to homelessness among citizens, the so-called secondary socialization, during which clients learn such new skills and knowledge that help them to survive in a state of homelessness [2].

There are different rules for these citizens, things have different values, it is a different dimension of the way of life. They all have a difficult stage behind them, there are events that they have buried deep inside them, which is why they are forced to learn to live according to the new lifestyle that brings them homelessness. In coping with the new situation in which citizens who have lost their homes find themselves, it is beneficial to have good and credible cooperation with a social worker who tries to help them to overcome the new life situation as best they can.

For a social worker, demographic data and living circumstances about homeless people are important information in terms of determining the right working method with the client. We cannot generalize the division of citizens who have lost shelter. In the professional literature, we encounter a division into certain groups of people living on the streets. This categorization is from the simplest, such as according to age, gender, education up to more complex, such as whether homelessness is hidden, overt or potential. Lešková [3] points out that the group of homeless citizens is very broad-spectrum. Each of them is a separate personality, they have their own individual worries. They are different from their fellow sufferers in appearance, in lifestyle, they all have their own way of living. At the same time, the common point is that everyone is homeless.

It is also important for social workers to know whether the client lives on the street or in a shelter for homeless people. In the following subchapters we point out the importance of this factor and we will characterize our clients according to their place of residence.

Homeless citizens living on the streets make minimal use of the benefits provided to them by social services. They live by their own rules, it is difficult for them to respect regulations and standards, and many things are not important to them. They perceive life differently than those who have a roof over their heads [4].

This lifestyle Vágnerová et al. [4] characterizes in such a way that the notion of time loses its role here, citizens living on the streets do not have a sense of the duties they have fulfilled in the past. Their daily routine is to meet their basic needs.

This group of homeless people most often use a low-threshold day center from the social services provided after the dormitory. Mátel [5] summarized the

most important advantages of these centers, which are mainly that the entry is not conditioned by zero alcohol tolerance, the client may be under the influence of drugs, and does not have to prove his identity. This anonymity will also facilitate the work of field staff in creating a partnership approach and long-term clients in building trust.

The other large group of homeless people are those who receive social services in a homeless shelter. Section 26 of the Social Services Act 448/2008 stipulates that a stay in a shelter is provided to a natural person for a definite period of time who does not have secured accommodation or housing. The client has the opportunity to use social counseling, he is provided with clothes and shoes. Among other things, he has the opportunity to perform personal hygiene, wash, iron and prepare meals [6]. The law also stipulates the length of stay in the shelter, which is often not possible to comply with, because the client has not been able to resolve his unfavorable situation even after a certain period of time. In this case, the clients will continue to be "residents" of the shelter. The required basic characteristic of a social worker, empathy, also plays a key role in this [6].

When working with a client, every social worker realizes that there are no two equal cases, which means that in order to make progress for clients, it is important that the working stages and methods are chosen correctly. The most common method is observation and interview, and the social worker can also build the necessary relationship with the client, which will greatly help in solving the client's problems.

When working individually with a client, a separate approach focused on the person is also important, who greatly appreciates the experience of the human being and the importance of his subjective reality. It also encourages each client to take responsibility for their lives, to trust their internal resources, which are

available and to everyone who is ready to embark on the path of self-awareness and self-acceptance. [7].

We agree with Bočáková [8] that we must keep in mind that a homeless citizen is a human being in all circumstances. Even if anything happens, either materially or spiritually, it never loses its dignity and rights. This should be the basis for contacting anyone who seeks our help.

When working with a client, the social worker must realize that each client is a personality, they all have different goals, desires, worries and opinions. Every homeless citizen has their individual gifts and the role of the social worker is to develop these talents. Despite the fact that, according to ordinary people, they are "only homeless", our long-term work with them has convinced us that even each of them excels in something that others do not have. We have experience with a client who draws nicely, the second has a musical talent, the third is an excellent chef, the fourth is manually skilled, etc. We want to point out that if we want, we will find something in each client that others do not have.

The effectiveness of helping clients also depends on the knowledge of the social worker, who "*should therefore have, in addition to basic social competences, also a number of key skills and competences, such as basic legal awareness, orientation towards labor market, financial literacy and seamless interpersonal communication with a predominance of assertive behavior.* " [9, p. 52].

We can also measure the success of a social worker according to the direction of his clients' lives. Social work with homeless citizens is demanding and long-term, it requires theoretical and practical knowledge. Social workers try to support their clients as much as possible and move them to a better life for their clients. Success is a positive not only for the client but also for the social worker.

With a well-defined history of social work with homeless people in addition to personal data, one of the most important data is the identification of the primary and secondary causes that led to the loss of home. In our long-term practice, were confirmed that “the phenomenon of homelessness is a broad-spectrum concept caused by several factors. So far, no state has succeeded in resolving this socio-pathological phenomenon, and this is a testament to the seriousness of the problem“ [10, p. 9]. Habánik [11] states that several causes play a role in the emergence of homelessness, and it follows that the loss of housing can threaten any of us. Because of this, we must provide help to anyone who is in a negative life situation and must urgently solve their problem, as neither of us knows whether he will later find himself in a similar situation.

We agree with these ideas, but for the sake of completeness, we must add, in our practice, that there are riskier and less risky sections of the population at risk of homelessness. When losing a home, the client's education, financial situation and family background play a key role.

An employed citizen with a university degree living in a fully organized family has a much less chance of becoming a homeless citizen than one who has no education, is unemployed and does not have a stable family background.

When working with homeless people, the primary important fact is to find out the primary cause of home loss in the client and help him to be able to clarify the negative life experiences. It is important to realize that “homelessness is always a combination of several factors. Home loss is usually preceded by a crisis. It can be a sudden loss of employment, excessive alcohol consumption, family breakdown. A crisis situation can cause an individual to neglect his or her economic situation and stop caring for himself ” [12, p. 65].

The most common causes of home loss are poverty, long-term unemployment, various types of addictions, mental disorders and the like.

Materials and methods. The aim of the research is to find out whether homeless people in Rožňava and its surroundings most often lead to homelessness. The town of Rožňava is located in the eastern part of the Slovak Republic.

When planning the composition of the research sample, we based on the knowledge that the most suitable are homeless people from the town of Rožňava and its surroundings. Due to the situation caused by the measures in the Covid-19 pandemic, we had the opportunity to personally address the homeless only in the Shelter for Homeless Citizens at the Diocesan Charity in Rožňava. The selection of respondents was intentional, based on availability.

The Diocesan Charity Rožňava has a low-threshold day center, a dormitory and a shelter for homeless people. Due to the fact that, according to the regulation of the Ministry of Health of the Slovak Republic, the Diocesan Charity in Rožňava has been in quarantine since October 2020, we did not differentiate in the selection of clients according to the use of the charity's social services. The reason was that the same rights and obligations apply to each client as long as they stay in the charity building. Quarantine means that clients can only leave the premises for a serious reason, and usually accompanied by a social service provider.

When choosing the method of our research, we considered an open-ended questionnaire to be the most appropriate. We have formulated the questions in such a way that they are understandable and coherent.

We presented a questionnaire with the same wording to those respondents whom we knew came from the vicinity of Rožňava. We were present at the completion of the questionnaires, and in some cases we assisted our respondents with the completion, given their literate and intellectual abilities.

The questionnaire consists of 19 questions, of which 13 had the structure open and 6 items are constructed as closed dichotomous. In the introduction, we ask about the socio-demographic data of the respondents.

At the beginning of the research, we also set partial goals. One of them is to find out which are the primary and secondary causes of homelessness, than to find out whether the participants cooperated with social workers even before the loss of home, to find out what would be the most effective prevention of the phenomenon according to the respondents homelessness, and ho did the respondents seek help from before the unfavorable life situation.

Results. The research was attended by 20 respondents who are recipients of social services of the Diocesan Charity in Rožňava, 11 (55%) women and 9 (40%) men. More than half of the respondents are between the ages of 40-60 (55%), 3 (15%) of them between the ages 20-30 and the same number between ages 60-70, 2 (10%) of them between ages 30-40 and one (5%) more than 70 years. When it comes to education, only one of the respondents has completed university, the remaining respondents have completed secondary education.

Reasons of losing home: mental disorders – 4 of them, family problems and conflicts – 2, addiction – 5, poverty – 6, unemployment – 1, other reasons – 2. In addition to these primary causes, respondents cited poverty as a secondary cause and the final stage before home loss. We also asked to the respondents about whether they sought help somewhere. Four respondents expected help from their friends, which in some cases they also received, but only as temporary help. Also, 4 respondents did not ask for help from others out of pride or hopelessness.

It is noteworthy that 8 of the respondents have 1 child, in the same proportion for men and women, 4 respondents are childless, 3 have 2 children and 5 have 3 or more children. Based on these data, we can conclude that most of our

respondents have a family and children of their own, and no matter who, there was no one to take care of them and offer them a roof over their heads.

The negative feedback for us is that only 3 of the respondents contacted social workers. This is due to the fact that most homeless citizens did not have information about what the concept of social work and social worker was until they found themselves on the street. It is also alarming because social work has been a university department since 1991. One of the respondents admitted to us that he had heard that there were social workers, but he had an idea of them that the social workers were officials and sat only at the desk all day. According to him, most citizens are homeless.

None of the respondents asked for help from other experts.

Next, we analyzed the findings of how homeless citizens perceive their own role in losing their homes over time. The sincerity of the respondents was a positive benefit for us, as they admitted that they blamed themselves for the loss of their home. They see a solution in the state giving them a helping hand. Respondents also suggested financial security and employment opportunities among the solutions. It follows that they entrust the task of preventing homelessness in full to the state.

We received subjective views on how respondents envisioned improving homelessness prevention. We state that 7 homeless citizens perceive the success of homelessness prevention in changing the social system. It is thought that if there was a different pension system, if more housing was built for citizens in need and material need benefits were calculated according to other criteria, fewer people would lose their homes.

Discussion. In our research, we sought an answer to the question of what negative socio-pathological phenomena cause home loss. As a secondary

circumstance, we examined who the respondents sought help with before losing their home, whether they themselves caused the loss of their home, and what they see as the most effective prevention of homelessness.

Based on the results of our research, we agree with Vanková [13], who also listed family problems, health problems and unemployment as causes of homelessness.

Ondrušková et al. [14] also dealt with the causes of homelessness according to their research, which was carried out in Bratislava, the leading cause of homelessness is leaving the parent's home, the second is the breakdown of the marriage, the third is indebtedness, and other causes. We state that in the capital, the leading causes are family conflicts, and only then do financial problems follow. Here we point out the difference, as in our research in the first place is poverty, financial problems. We explain this difference by the fact that Bratislava has a large city with several work matters. Rožňava is one of the smaller towns, which means that there are also fewer job opportunities.

The European Commission also cites the typical causes of homelessness in the European Union. He is the first to mention poverty and unemployment. This data was also confirmed by our research. In our practice, we encounter failure to find job opportunities for our clients on a daily basis. We can deduce this from the fact that if a person loses his job around the age of 50, he will find it more difficult to find a new job than his younger fellow citizens. If it is combined with lower education, it means another barrier to client. Despite the fact that our clients are actively looking for work, they are only successful in exceptional cases. If they manage to find something, it is only a work agreement, not a proper employment contract. Those agreements are only for a short period of time, and without a

permanent employment, our clients have no hope of starting a new life outside the Diocesan Charity.

For the reasons leading to the loss of home, we analyzed that the participants were looking for help if it was already clear to them that they were in danger of losing their home. 9 out of 20 participants sought help from their family, which is natural, as everyone seeks help from their loved ones. From the point of view of social work, it is remarkable that only 3 contacted a social worker. The loss of home could not be prevented for these respondents, but at least with the help of social workers they did not find themselves in the open air. There are also cases where the help of a social worker prevented the loss of a home, but their number is not known to us, as our research respondents were citizens who had already lost their home. Here we would like to point out the prevention of homelessness, which is not enough in our society. Based on this research question, we want to emphasize the cooperation of the social worker with the client, which should be based on mutual trust. We see the biggest shortcomings in the fact that citizens are not aware of social work, they do not know where and when they can turn to social workers.

Feranecová [15] leads the presence of poverty in our society to the wrong social system, to the unjust organization of the whole society and points to a low amount in material need, which does not even reach the subsistence level. We agree with those ideas, as 1/3 of our respondents also accused the social system of our state of creating a phenomenon of homelessness when asked about homelessness prevention.

According to our research, respondents see the emergence of the phenomenon of homelessness mainly in a poor social system in terms of contributions in material need and a low amount of old-age pensions. Others see

the solution in constant financial security and in the created job opportunities of cities that would be suitable for homeless people. The whole prevention would it was that every citizen of our society still had as much money at his disposal as would be sufficient to cover housing and basic living needs. It sounds utopian, but if we simplify the whole problem, it is an obvious solution to homelessness. If everyone could pay the housing costs, no one would be on the street.

Conclusion. Based on our theoretical knowledge from the studied literature and from the results of our research, we can conclude that social workers should stay more in the field where socially disadvantaged citizens are located. The aim of this would be to make them accessible to anyone who needs help, so that they can deal with time and avert some socio-pathological phenomena, thus preventing the loss of home. Social workers should also find the citizens themselves who need help, and not rely on the citizen to find a social worker on his own if he has a problem. They should also improve cooperation with authorities, health institutions and other professionals. Also they should work with clients who are from at-risk social groups and at risk of losing their homes (unemployed, dependent, citizens who have been released from prison and from various facilities, indebted citizens, citizens living in poverty).

It is important that the social worker does not act in place of his clients, but that it is cooperation between the client and the social worker. The technique of working with the client would also be important for positive results when working with clients. Here we would highlight information, clarification and encouragement.

In communication, social workers should pay attention to simplicity and comprehensibility. Given that the most common method in social work is

interviewing, it would be important to use paraphrasing, summarizing and melting ice for the benefit of the client.

We see homelessness prevention in the promotion of social work, so that as many citizens in need have sufficient knowledge of the help that social workers can provide.

It is important to lead clients to self-help. At the same time, the premature burnout syndrome of social workers must be prevented, which could have a negative impact on solving client problems in particular.

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Economic sciences

INNOVATIVE ACTIVITY OF INDUSTRIAL ENTERPRISES AND ITS IMPACT ON THE ECONOMIC DEVELOPMENT OF UKRAINE

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Abstract. *The article presents the essence of the concept of "innovation", describes its significance for the development of industrial enterprises and the economy of Ukraine as a whole. The basic principles of innovative activity were also determined, which include the orientation on the innovative way of development of the economy of Ukraine; determination of state priorities of innovative development; formation of the regulatory framework in the field of innovation; creating conditions for the preservation, development and use of domestic scientific, technical and innovative potential; ensuring the interaction of science, education, production, financial and credit sphere in the development of innovation; effective use of market mechanisms to promote innovation, support for entrepreneurship in research and production; implementation of measures to support international scientific and technological cooperation, technology transfer, protection of domestic products in the domestic market and its promotion on the foreign market and others.*

Also, the main indicators that determine the innovation activity of the state and their dynamics are analyzed. The indicators that determine the innovation activity of the country include the Global Innovation Index, Innovation Input Subindex, Innovation Output Subindex. The model of influence of innovative activity on economic development of Ukraine is developed, its basic factors are defined and the estimation of the received model is carried out. The resulting feature was the volume of nominal gross domestic product of Ukraine, the following items were chosen as factors: the share of the number of innovatively active enterprises in the total number of industrial enterprises,%; innovation costs, UAH million; the share of the number of enterprises that implemented innovations in the total number of industrial enterprises,%; introduced new technological processes, units; the share of the volume of sold innovative products in the total volume of sold products of industrial enterprises,%. The results of evaluation and analysis showed that the constructed model is adequate and consistent with reality.

Keywords: *innovation activity, technologies, economic development, principles of innovation activity, innovation index, econometric model.*

Formulation of the problem. The introduction of new technologies is one of the most important factors that ensure the effective development of the national economy. The innovative activity of enterprises is relevant for Ukraine, as it will be able to ensure both increasing the competitiveness of products and expanding markets through constant updating of equipment and technologies. In addition, the development of innovation will help to effectively use the existing scientific and technological potential and stimulate its growth in the future.

Today, in connection with the European integration processes in the country, the problem of developing innovative activities of industrial enterprises is becoming especially relevant.

Analysis of recent research and publications. Back in the 60s of the twentieth century began to study the problems of innovative development, precisely in the period of accelerating scientific and technological progress. Further study, initiated by J. Schumpeter, was carried out by J. Bright and his followers. Among domestic scientists the issues of innovation activity of the enterprise were dealt with by: SS Harutyunyan, VA Grosul, AV Klyuchnik, I.G. Яненкова, O.B. Levkivsky and others. However, despite the large number of studies on this topic, the issue of the impact of innovative activities of industrial enterprises on the economic development of Ukraine still remains relevant.

The purpose of the article. The purpose of the study is to determine the main factors of innovative activity of industrial enterprises and their impact on the economic development of Ukraine based on the application of economic and mathematical modeling.

Main material. At the present stage of the country's functioning, the activity of enterprises is one of the factors that significantly affects economic development. In particular, the development of innovative activities of industrial enterprises leads to both increasing competitiveness and helping to solve a significant part of economic, environmental and social problems. Therefore, determining the role of this phenomenon in our time is necessary.

The innovative activity of the enterprise is a complex process of creation, use and distribution of innovations (innovations) in order to obtain competitive advantages and increase the profitability of its production. In a market economy, this type of enterprise is one of the most important factors that allows the company

to take a stable market position and gain an advantage over competitors in the field that is the area of its commercial interests. Innovative activity includes:

- production and distribution of fundamentally new types of equipment and technology;

- progressive intersectoral structural changes;

- implementation of long-term scientific and technical programs with long payback periods;

- funding of basic research for the implementation of qualitative changes in the state of productive forces;

- development and implementation of new resource-saving technology designed to improve the social and environmental situation.

In Ukraine, innovation activity is regulated by the Law of Ukraine "On Innovation Activity". According to this law, the main purpose of the state innovation policy is to create socio-economic, organizational and legal conditions for effective reproduction, development and use of scientific and technical potential of the country, ensuring the introduction of modern environmentally friendly, safe, energy and resource-saving technologies. types of competitive products. The main principles of state innovation policy include [1]:

- focus on the innovative way of economic development of Ukraine;

- determination of state priorities of innovative development;

- formation of the regulatory framework in the field of innovation;

- creating conditions for the preservation, development and use of domestic scientific, technical and innovative potential;

- ensuring the interaction of science, education, production, financial and credit sphere in the development of innovation;

- effective use of market mechanisms to promote innovation, support for entrepreneurship in research and production;

- implementation of measures to support international scientific and technological cooperation, technology transfer, protection of domestic products in the domestic market and its promotion on the foreign market;

- financial support, implementation of favorable credit, tax and customs policies in the field of innovation;

- promoting the development of innovation infrastructure;

- information support of subjects of innovation activity;

- training in the field of innovation.

Usually in European countries to determine the degree of innovation development in each country is calculated by the so-called generalized innovation index, or global innovation index, which is a comprehensive indicator that takes into account data from different areas of innovation. Thus, in 2020, Ukraine ranked 45th in the overall ranking of the Global Innovation Index 2020 and scored 36.32 points out of 100. In particular, if we analyze each component of the Global Innovation Index, in the field of educational innovation, Ukraine ranked 23rd, which is 20 steps higher than previous year. In the field of political and operational stability 123rd place (2 steps higher than previous year), government efficiency - 93rd place (2 steps higher), rule of law - 109th place (2 steps lower), regulatory policy - 88th place (6 steps higher), ease of starting a business - 52nd place (4 steps lower than previous year).

As for the innovative activity of industrial enterprises, according to the Ministry of Economy of Ukraine, in 2019, 782 enterprises carried out innovative activities in industry. At the same time, the share of the number of industrial enterprises that implemented innovations in the total number of industrial

enterprises was 13.8%. By type of economic activity, the largest shares of innovatively active enterprises account for food production - 16.8%, production of machinery and equipment (not included in other groups) - 10.2%.

Also, according to the statistics of the Ministry of Economy of Ukraine, of the total number of innovatively active enterprises carried out: internal and external research - 24.4%; purchase of machinery, equipment and software - 64.7%; acquisition of external knowledge - 4.5%; other works - 20.6% of enterprises [2].

Table 1 shows the dynamics of the values of the Global Innovation Index, the Innovation Input Subindex, which includes the foundations that promote development, determine the environmental aspects conducive to innovation in the economy and the Innovation Output Subindex (index is the result of innovative activity in the economy) for Ukraine during 2016-2020.

Table 1. Dynamics of values of innovation indices for Ukraine during 2016-2020

Indicator	**2016**	**2017**	**2018**	**2019**	**2020**
Global Innovation Index	35,72	37,62	38,52	37,4	36,32
Innovation Input Subindex	-	-	40,45	40,73	40,14
Innovation Output Subindex	-	-	36,59	34,07	32,49

Source: calculated by the author based on [3 - 7]

Let us represent the dynamics of the values of the selected innovation indices on the graph (Fig. 1).

As can be seen from Figure 1, during the study period, the Global Innovation Index experienced both growth and decline. In particular, in 2018 it was at its peak value of 38.52, but since 2019 the value of the index has decreased slightly. There are no values of the Sub-index of innovation of the deposit and the Sub-index of innovation of the issue for 2016-2017. In 2019, the value of the Innovation Input Sub-Index increased to 40.73, although in 2020 it decreased to 40.14. Innovation

output sub-index underwent a negative trend during 2018-2020, which indicates a decrease in innovation activity in Ukraine.

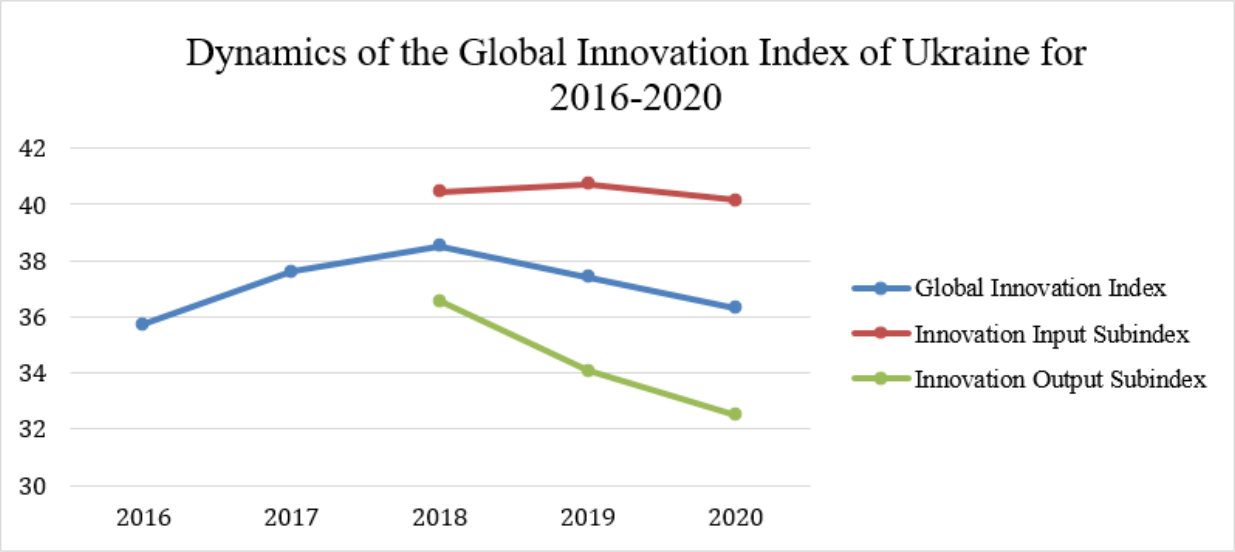

Fig.1 Graph of values of innovation indices for Ukraine during 2016-2020

In modern conditions it is necessary to determine the role and importance of innovative activities of industrial enterprises for the economic development of Ukraine. It is necessary to find out its main factors and show what impact they have on the living standards of the population.

When building an econometric model, the first step is to form the purpose of the study and the choice of factors that determine the studied economic phenomenon or process. Then the necessary statistical information is collected on selected factors. The next steps are the specification of the model, ie the choice of the correct functional form, evaluation of its parameters and verification of the model, ie verification of adequacy. And finally, the interpretation of the results. All data for the study were taken for the period 2000-2019.

During the study, 5 indicators were selected to build the model, which are presented in table 2.

Table 2. Baseline indicators for building an economic-mathematical model, 2000-2019

Nominal GDP, UAH million	Y
Share of the number of innovatively active enterprises in the total number of industrial enterprises,%	X1
Expenditures on innovations, UAH million	X2
Share of the number of enterprises that implemented innovations in the total number of industrial enterprises,%	X3
New technological processes have been introduced, units	X4
Share of the volume of sold innovative products in the total volume of sold products of industrial enterprises,%	X5

Source: calculated by the author based on [8][9]

After normalization of variables and elimination of negative consequences of multicollinearity by means of the Stata software the final model has the following look:

$$\ln(Y) = 3.72 + 0.81 * \ln(X2) - 0.25 * X5 \qquad (1)$$

According to this model, the following conclusions can be drawn: with a significance level of 99%, the variable cost of innovation is significant according to the last regression, and if the cost of innovation of industrial enterprises increases by 1%, nominal GDP will increase by 0.81%.

With a significance level of 99%, the variable share of sold innovative products in the total sold products of industrial enterprises is significant according to the last regression and if the share of sold innovative products in the total sold products of industrial enterprises increases by 1%, nominal GDP will decrease by 0.25% .

In the process of conducting this study, a close correlation was identified between the phenomenon of innovative activity of industrial enterprises and economic development of Ukraine. This model showed that among the 5 main indicators statistically significant were only 2 (costs of innovation and the share of sales of innovative products in the total sales of industrial enterprises). At the same

time, the variable share of the volume of sold innovative products in the total volume of sold products of industrial enterprises showed a negative impact on the standard of living of society. The coefficient of determination, which shows how much the factors describe the selected phenomenon is 96%. Verification of the model for the adequacy of reality using the F-test gave the following results:

$$F_{\text{розр}} = 20{,}28$$

$$F_{0{,}01} = 15{,}14$$

Therefore, it can be argued that the model is adequate and true [10].

Conclusions. Innovative activity contributes not only to the development of the enterprise, but also to ensuring the stability of its functioning in the market, increasing the efficiency of its resource potential and compliance of its work with market requirements, which is essential for economic development, especially in high competition. During the study it was found that for successful innovation the company must take into account the national principles of innovation, defined by current legislation and adhere to them, which will allow to implement innovation programs without significant costs.

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Technical sciences

APPLICATION OF THE PROVISIONS OF THE GENERAL THEORY OF MEASUREMENTS WHEN SOLVING SELECTION PROBLEMS

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Abstract. *The impetus for this publication was an article on the possibility and need to use the general theory of measurement in judicial practice based on considerations of the state and prospects of judicial decisions by the judiciary, as they solve the problem of choice (punishment or justification) as a result expert evaluation in conditions of uncertainty.*

The article discusses the possibility of disseminating methods and tools for decision-making in the field of metrology as a result of measurement and expert evaluation in conditions of uncertainty in such areas as pedagogical and general qualimetry. To solve the problem, it is proposed to use in educational practice to assess the level of learning (level of acquisition of knowledge, skills and abilities) of subjects of learning four-point scales of the order. Their compatibility with the stobal rating scale and the corresponding ESTC scale is shown. The corresponding nomogram is given, the logarithmic four-point scale of which is obtained on the basis of the probabilistic-information approach.

The procedure of data processing of expert assessment (measurement) in pedagogical qualimetry is considered, which can be partially used for processing the characteristics of objects of comparison (OC) in qualimetry. The possibility of applying traditional and improved four-point scales and elements of fuzzy mathematics in qualimetry in the construction of OC models.

As directions of implementation of the principles of the general theory of measurements and procedures of expert estimation (measurement) at the decision of problems of a choice it is offered to improve legal, normative, directive and other documents on metrological activity concerning concrete subject area and objects of comparison, and distribution of their scope.

Keywords: *metrology; qualimetry; uncertainty; order scales*

Introduction. Searching for information on the subject of the article in the Google Scholar search engine did not return any results.

In the article [1] the directions of improvement of scientific, methodical and organizational bases of the general theory of measurements (GTM) for the purpose of their application at an expert estimation in various branches are considered. The impetus for its publication was the article [2], which deals with the possibility and need for the use of GTM in judicial practice, as the judiciary makes a court decision as a result of the results of expert evaluation in conditions of uncertainty. The considerations of the publication [2] concern the comparison of different levels and means of decision-making in metrology and jurisprudence and are extended [1] to such areas as pedagogical and general qualimetry (table 1). Objects of comparison (OC) and basic objects (BO) of comparison mean products (products, services, etc.) or subjects of study (SS).

Table 1. Levels and means of decision-making in metrology and other fields

Metrology	Judicial practice	Pedagogical qualimetry	General qualimetry
State standards (Gosstandart)	Laws (Supreme Court)	Education standards (from a certain field of knowledge)	Legislative (regulatory) documents
Working standards	Courts of second instance	Fundamental printed works (monographs, textbooks, etc.) and their sections	List of properties of BO
Measuring instruments	Courts of first instance	Expert teacher (group of experts) and assessment tools SS-OC	Expert (group of experts) and means of evaluating / measuring the properties of OC

Presentation of the main material. In [3] the use of a four-point scale and an improved four-point scale (IFS) of the order in the system of assessment of the level of learning (level of acquisition of knowledge, skills and abilities) of SS, which makes the use of ten- and twelve-point scales is impractical. The indicator of learning (preferably integrated) shows the intermediate or final learning

outcome. The Bologna Declaration recommends for use in educational practice the rating scale (RS), the corresponding ESTC-scale and the control procedure, "tied" to the division of the entire scope of a particular discipline into blocks of content modules (BCM) and content modules (CM), and the accumulation of points obtained during the control. Probabilistic-information approach to the evaluation procedure [4] allowed to obtain an expression for determining the evaluation on any logarithmic L-score scale:

$$Q_L = N_i + log_2[- 2^L /((2^L - 1)q - 2^L))], \quad (1)$$

where N_i *i*s the initial mark of the scale; $L = |N_e - N_i|$ – scale length; N_e is the end mark of the scale.

In fig. 1 shows a graph of the dependence of the estimates Q of two-, three-, four-, ten- and twelve-point scales, the beginning of which is combined with zero, on the share q of the returned SS information during control.

Here q – the share of information returned by the subject of training during testing, written or oral survey – the numerical result of the assessment of learning for CM, BCM or in general for the discipline:

$$q = n_в / n_з, \quad (2)$$

where n_c – the number of correct answers, decisions; n_t – the total number of questions, tasks, tasks that determine the content of knowledge of the subject area.

The value of $q = 1$ is an exemplary result. We emphasize that the presence of a sample (standard, in terms of metrology) involves measuring on a scale of relations.

This procedure in pedagogical qualimetry can be implemented based on the concept of information entropy, but this issue needs a separate discussion.

Analysis of functional dependences (see fig. 1) shows that the scatter of the values of estimates increases with increasing length of the scale L, especially sharply for values of $q > 0.8$. Thus, it is logical to assume that the use of logarithmic scales longer than three does not make sense, and the use of traditional and advanced four-point scales as the basis for expert evaluation (in particular, the level of study) will be justified.

Scores on a logarithmic four-point scale (LFS):

$$Q_{LFS} = 2 + log_2[– 8/(7q – 8)]. \quad (3)$$

Approximation $Q_{LPS} = f(q)$ three lines (fig. 2) in the range of estimates 2.00-3.00; 3.00-4.00; 4.00–5.00, which correspond to the values of q in the ranges 0–0.57; 0.57–0.86; 0.86–1, does not change the “logarithmic essence” of the approximated logarithmic four-point scale (ALFS), but allows to simplify the calculations of estimates.

In fig. 2 shows graphs of four-point advanced (traditional), logarithmic and approximate scales. We emphasize that the values of ALFS estimates differ from the corresponding LFS values, but their relative position does not change, which is decisive. The maximum given errors of estimates in the approximation intervals are 1/57, 1/29 and 1/14 of the score, respectively.

Nomogram (fig. 3), which combines IFS, RS, ALFS and ESTC-scale, allows you to use these scales to assess the level of study of SS in any combination without additional calculations, and the end result is presented in a predetermined

scale or as a coefficient of compliance in the range of normalized values from zero to one, or as a percentage (actually – on a rating scale)/

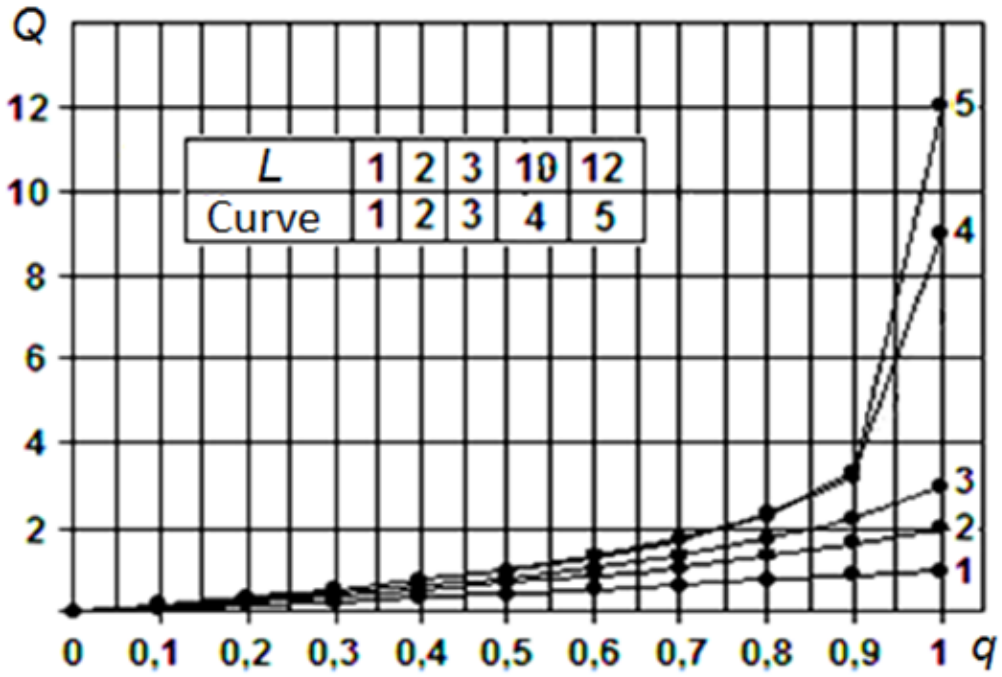

Figure 1. Graphs of dependences $Q = f(q)$

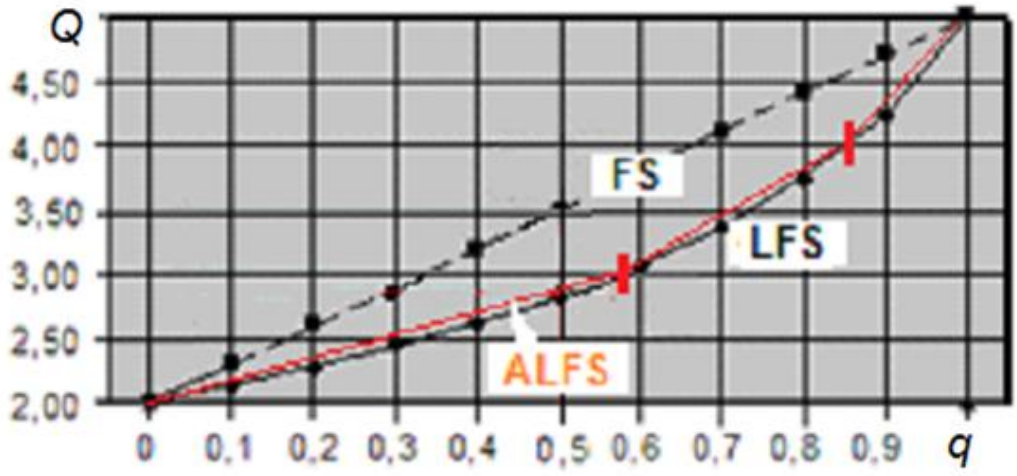

Figure 2. Graphs of dependences $Q_{FS} = f(q)$

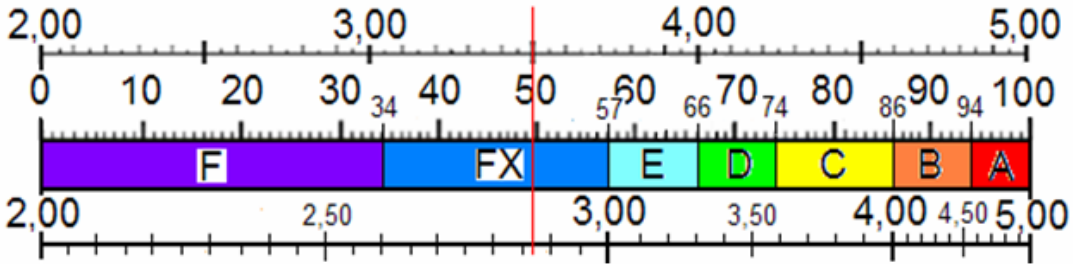

Figure 3. Nomogram of assessments of scales of pedagogical qualimetry

As the example shows (see fig. 3), a fixed score of 3,50 on the advanced four-point scale corresponds to a score of 50 on the stem scale (or a coefficient of conformity of 0,50), FX on the ESTC scale, and 2,83 on the approximated logarithmic four-point scale.

Note that the introduction of RS was accompanied by "voluntarism" by higher education institutions (HEIs), as shown in table 2 for generalized data [5] and universities of authors and others. The practical convergence of the declared and calculated by formula (3) estimates for RS in the ranges of the FS and ECTS scale suggests that the Bologna Declaration proposed the use of the system of stem rating assessment is based on the concept of probabilistic-information approach. This approach is acceptable for test control (in particular, using a computer with special software as a means of assessing SS), focused on "covering" the total number of questions (tasks, tasks) of a certain amount of educational material taken as a sample.

Thus, the procedure for processing expert evaluation data in pedagogical qualimetry consists of a sequence of the following actions:

- formation of sets of results of assessment of knowledge, skills and abilities of subjects of training in one of two ways: in an absolute scale as a share of the

returned SS information at control; in a traditional four-point scale or an advanced four-point scale;

- calculation of average grades in an improved four-point scale;

- the expression of average grades in a form acceptable for the construction of the rating list in the two-point, logarithmic four-point, rating scale and the corresponding ECTS scale or otherwise.

Table 2. Scores on different scales of order

Score on a four-point scale	Rating ECTS	Grades on the stem scale		
		declared	calculated	applied
Vidminno	A	94-100	94-100	81-100
Dobre	B	86-94	86-94	74-89
	C	74-86	74-86	61-75
Zadovilno	D	67-74	66-74	50-74
	E	57-67	57-66	35-60
Nezadovilno	FX	34-57	34-57	22-59
	F	0-34	0-34	0-34

The quality of products (services, etc.) is usually assessed by comparing products with each other or with the base object.

Any basic object (BO) is characterized by a set of its quantitative and qualitative properties, which consists of experts who attribute the scores of the FS according to the rules associated with the statements "Yes" – 5, "Rather yes, than no" – 4, "Rather no, than yes" – 3, "No" – 2 in response to questions such as "Is the property inherent in the base object or not?" The result of this procedure is an information model of the basic object (actually – a sample – an analogue of the standard or working standard) in the thesaurus (dictionary) and the alphabetical index of the properties of the BO.

Quantitative characteristics of the properties of the object of comparison are obtained by measurements by appropriate methods (techniques). Uncertainty-based measurement results can be provided as membership functions.

Qualitative characteristics of the OC are evaluated by the same method of assigning points, as described above, for judgments such as "Does this property match the object of comparison and BO?" The obtained data of non-numerical nature are used to construct the resulting characteristic membership function (RCMF). Fasification of RCMF using the method of center of gravity [6] gives the desired result - an integral indicator of the quality of OP as an arithmetic mean, which does not contradict the theory [7] and confirmed by calculations [8].

Conclusion. The extension of the principles of GTM to the areas of activity where decisions are made on the basis of expert assessment / measurement requires:

- improvement of legal, scientific, methodological, organizational principles and evaluation (measuring) procedures;

- finalization of normative (directive, guiding, administrative and other) documents on metrological activities related to a specific subject area and specific objects of comparison, and expansion of their scope.

Establish the possibility of using different types of scales to solve the problem of comparing objects of comparison.

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Chemical sciences

SINGLE CRYSTAL $NaMn_6P_7O_{24}$ AND STRUCTURE

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Abstract. *Complete X-ray diffraction analysis has been performed to study single crystals of synthesized phosphates $NaMn_6(P_3O_{10})(P_2O_7)_2$. According to their structure, the compounds belong to the monoclinic crystal system (space group $P2_1/m$) with lattice parameters: a=5.350 Å, b=26.643 Å, c=6.566 Å, β=107.25^0); Z=2, ρ=3.575 g/cm^3. The crystalline structure of synthesized phosphates of $MMn_6(P_3O_{10})(P_2O_7)_2$-type is based on the space framework composed of octahedron chains $[MnO_6]$ joined by edges and tetrahedrons $[PO_4]$ combined into $[P_2O_7]$ and $[P_3O_{10}]$ groups. The polyhedral chain of mangan unit cell consists of three distorted octahedra with the length of Mn-O bonds within 2.090-2.442 Å. The calculated values of tensor g for the synthesized phosphates agree with the results of magnetochemical studies and fall within 1.98-1.99 Å. The obtained spectra of electronic paramagnetic resonance for synthesized double phosphates of manganese (II) are typical and specific. The compounds have been studied using the following techniques: DTA, EPR-spectroscopy, magnetochemistry; the*

dependence of dielectric constant on the temperature has been measured. Slight antiferromagnetic interaction has been detected in octahedron chains [MnO_6].

This may be attributable to the weak interaction between paramagnetic centers in the structure of $MMn_6(P_3O_{10})(P_2O_7)_2$-type phosphates. With the rise in temperature, the values of dielectric constant increase, which indicates that obtained compounds of $MMn_6(P_3O_{10})(P_2O_7)_2$-type can be used as thermally stable microwave dielectrics. The specified spectrum of physicochemical properties of synthesized phosphate $NaMn_6(P_3O_{10})(P_2O_7)_2$ raises the possibility of their use in the development of functional materials, which can be utilized in various fields of science and technology.

Keywords: *complex phosphates, EPR, RSA, flux crystallization, XRD.*

Introduction. Constant development of science and technology warrants further studies of new compounds and generation of materials from them. Recently, scientists have made significant progress in the field of inorganic chemistry of molten salts, in particular, the synthesis of simple and double phosphates of alkali and polyvalent metals. These compounds can exhibit a wide range of magnetic, nonlinear optical, catalytic and electrophysical properties and are used as monocrystals and ceramics [1-3].

Melts of alkali metals are widely used as media for the synthesis and growing of single crystals of various phosphates and at the same time they are universal solvents of multivalent metal oxides. [4]. Directed synthesis of phosphate compounds with various properties warrants in-depth study of their crystalline structure and evaluation of physicochemical properties to be used in the development of new technologies.

Monocrystals of synthesized double phosphates of alkali metals and manganese have been studied using the following techniques: DTA, EPR-spectroscopy, magnetochemistry; the dependence of dielectric constant (ε) on the temperature has been measured.

Experimental. X-ray diffraction analysis has been performed to study single crystals of synthesized phosphates $NaMn_6(P_3O_{10})(P_2O_7)_2$. The crystalline structure of synthesized phosphates of $MMn_6(P_3O_{10})(P_2O_7)_2$-type is based on the space framework composed of octahedron chains [MnO_6] joined by edges and tetrahedrons [PO_4] combined into [P_2O_7] and [P_3O_{10}] groups (Table 1). The polyhedral chain of mangan unit cell consists of three distorted octahedra with the length of Mn-O bonds within 2.090-2.442 Å (Fig. 1).

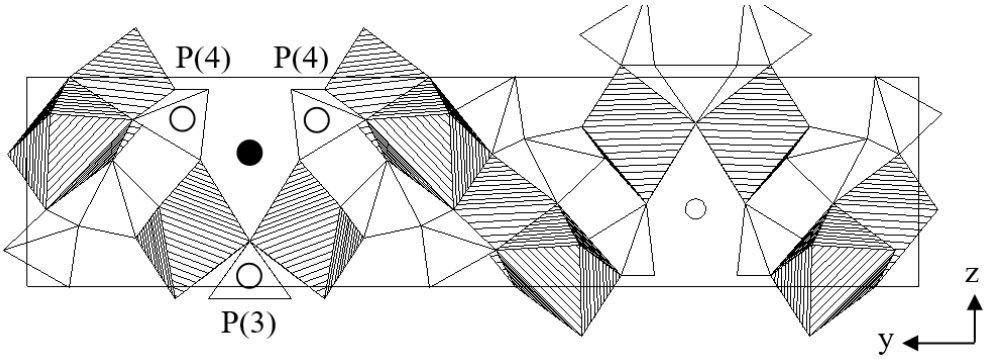

Fig 1. Proection of $KMn_6P_7O_{24}$ on yz.

[MnO_6] chains have been discovered for the first time in the structure of $MMn_6(P_3O_{10})(P_2O_7)_2$ [5]. The presence of such composite structural fragments may affect the physicochemical properties of obtained phosphates. The study of "composition-structure-property" relation for the mentioned above compounds will allow for clear identification of the factors that underlie specific characteristics of complex double phosphates.

Table 1

Atom	*x/a*	*y/b*	*z/c*	U_{eq}
Mn(1)	3811(1)	6832(1)	7198(1)	6(1)
Mn(2)	-2922(1)	5979(1)	10853(1)	6(1)
Mn(3)	3145(1)	5445(1)	3142(1)	7(1)
Na(1)	-2194(1)	7500	3714(1)	17(1)
P(1)	-1824(1)	6093(1)	6168(1)	4(1)
P(2)	2087(1)	5243(1)	7949(1)	3(1)
P(3)	-398(1)	7500	9044(1)	3(1)
P(4)	2484(1)	6681(1)	11902(1)	4(1)
O(1)	162(3)	6483(1)	6159(2)	14(1)
O(2)	-3448(3)	6223(1)	7650(2)	7(1)
O(3)	-3574(3)	5956(1)	3956(2)	7(1)
O(4)	-460(3)	5575(1)	7071(2)	15(1)
O(5)	3700(3)	5481(1)	10015(2)	7(1)
O(6)	3573(3)	5217(1)	6315(2)	9(1)
O(7)	891(3)	4741(1)	8258(2)	7(1)
O(8)	-3238(4)	7500	7809(3)	8(1)
O(9)	1536(4)	7500	7786(3)	6(1)
O(10)	38(3)	7036(1)	10572(2)	8(1)
O(11)	3611(3)	6946(1)	13979(2)	9(1)
O(12)	4383(3)	6664(1)	10574(2)	7(1)
O(13)	1099(3)	6194(1)	12010(2)	7(1)

In order to confirm the presence of Mn^{2+} in double phosphates with various phosphate anions we have studied the EPR spectra using polycrystalline samples. Fig. 1 shows the EPR spectra of polycrystals of $NaMn_6(P_3O_{10})(P_2O_7)_2$ double phosphate at 23°C. The spectral lines have specific widening due to weak exchange between paramagnetic centers $[MnO_6]$ in octahedral chain. The calculated values of tensor g for the synthesized phosphates agree with the results of magnetochemical studies and fall within 1.98-1.99A. The obtained spectra of electronic paramagnetic resonance for synthesized double phosphates of manganese (II) are typical and specific [6].

Results and discussion. X-ray diffraction analysis has been performed to study single crystals of synthesized $MMn_6(P_3O_{10})(P_2O_7)_2$ phosphates. According to

derivatographic analysis, $NaMn_6(P_3O_{10})(P_2O_7)_2$ compound are rather stable and do not melt at the temperatures up to 1000 °C. When heated under dynamic conditions with the rate 5 deg./min, the compounds don't lose their mass, which is also indicative of Mangan (II) content in the double phosphates.

Magnetochemical properties of the compounds result from the X-ray characteristics of synthesized phosphates and their structural features, in particular, the presence of octahedral chains of mangan. Temperature dependence of the magnetic susceptibility product χT and temperature for $NaMn_6(P_3O_{10})(P_2O_7)_2$ compounds is given. The χT value for $NaMn_6(P_3O_{10})(P_2O_7)_2$ obtained at room temperature is 11.8 Bohr magneton (μ_B) and is lower than the theoretical value (17.74 Bohr magneton). The χT values change little, if at all, within the temperature range 300-100 K, and sharp decrease in the magnetic susceptibility within 100-4 K is indicative of the antiferromagnetic interaction between the magnetic centers of manganese.

The best agreement of the experimental results with theoretical data within the temperature range 4-40 K was obtained at J=0.70(7) cm^{-1} and g=1.99 and consistency index R^2=0.995. The χT value of the double phosphate changes little, if at all, within the temperature range 100-300 K. The decrease in χT value is more significant at the temperatures below 100 K, which is indicative of the weak antiferromagnetic interaction between the triangles of manganese.

The synthesized compounds have been studied for the dielectric constant (ε) – temperature relation. The relation was measured using microwave microscope at 30 GHz. Complex double phosphates $NaMn_6(P_3O_{10})(P_2O_7)_2$ demonstrate abnormal dependence of (ε) on the temperature within the range of 60-100 °C – decrease in dielectric constant. This may be attributable to the weak interaction between paramagnetic centers in the structure of $MMn_6(P_3O_{10})(P_2O_7)_2$-type phosphates.

With the rise in temperature, the values of dielectric constant increase, which indicates that obtained compounds of $MMn_6(P_3O_{10})(P_2O_7)_2$-type can be used as thermally stable microwave dielectrics.

Conclusion. The specified spectrum of physicochemical properties of synthesized phosphate $NaMn_6(P_3O_{10})(P_2O_7)_2$ raises the possibility of their use in the development of functional materials, which can be utilized in various fields of science and technology.

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Chemical sciences

ELECTROCHEMICAL RESEARCH COMPLEX OF COBALT FORMATION PROCESSES IN SOIL OF UKRAINE

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Abstract. *Electrochemical parameters were developed to determine the concentration of Co (II) in the soil in the range 1.0-1·10^{-4} mg/kg on a gold electrode using a new electrochemical method of pulse inversion chronopotentiometry. The sorption of complex cobalt-containing ions by various soils has been electrochemically studied. Based on the obtained data, the percentage of absorbed Co (II) was calculated. Cationic complexes of cobalt - $[Co(H_2O)_n]^{2+}$, $[Co(NH_3)_n]^{2+}$, $[Co(CSN_2H_4)_n]^{2+}$ - almost completely adsorbed soils. Anionic complexes - $[Co(P_2O_7)_n]^{2-4n}$, $[Co(P_3O_{10})_n]^{2-5n}$ and [Co EDTA]$^{-2}$ - remain largely mobile in the soil profile. Soil supersaturation of various kinds of chemicals sterilizes it and killing a biological components that form a complex ecological system, as well as leads to over-saturation of agricultural products with harmful to human substances.*

One of the most important trace elements is cobalt. The main physiological role of cobalt is to increase the activity of various enzymes, which are the catalysts

of many processes in plant organisms. Investigated that cobalt has a positive effect on the accumulation of chlorophyll, increases its resistance to destruction in the dark, increases the strength of the chlorophyll-protein complex.

Cobalt is a constant part of the animals and humans blood. This element plays an important role in oxidation-reduction processes, the metabolism of carbohydrates and fats, increases the use of aminoacids for the synthesis of proteins by the body. The sorption effect depends on the charge of complex ions, their strength, and also on the parameters of complex ions. Chelate formation of Cobalt with organic polydentant ligands to some extent simulates many natural processes. Complexes of this type are sufficiently stable and can be used as independent micro fertilizers or in combination with macro components. Studying biohumus was found that cobalt passes into the solution of 0.02M Na_2EDTA + 0.09M NH_4Cl by the mechanism of competitive complexation, its transition to the HCl solution is due to protonation of the functional groups of biohumus with the metal is bound.

Keywords: *electrochemical method; gold electrode; microelement cobalt; sorption processes; soils.*

Introduction. All ecological chains connected to a human life coming through the soil. Any process of metabolism between human and space energy, atmosphere, hydrosphere, lithosphere have got started in there. Soil is the most sensitive indicator of the contamination of landscapes, a specific element of the biosphere, which is not only able to accumulate heavy metals but also act as a natural buffer that controls the process of transferring chemical elements and compounds to the atmosphere and hydrosphere. It has the property of self-healing,

that is, to counteract the toxic effects of chemicals. This is the barrier (buffer) function of the soil as an element of the landscape [1].

The constant flow of heavy metals in the soil leads to the formation of areas of increased ecological toxicity and changes the nature of the elements migration and some geochemical parameters. The interaction of metals with soil occurs by the type of reactions: ion exchange and adsorption, sorption, deposition - dissolution of solids, complex formation, acid-base reactions and oxidation-reduction reactions. The velocity and direction of the transformation processes of the heavy metals depend on the reaction of the soil environment, the granulometric composition of the soil, the content of humus and other factors [1]. Therefore, analytical control of the content of heavy metals at the trace concentrations level is necessary for the environmental safety of human life.

The theoretical part. The widespread use of mineral fertilizers, pesticides, and chemical soil reclamation at the initial stage increased the yield of crops, but led to many negative consequences: loss of humus, destruction and transformation of soils into an indifferent mass, unable to absorb and retain water. Its also undergoes by water and wind erosion.

Soil supersaturation of various kinds of chemicals sterilizes it and killing a biological components that form a complex ecological system, as well as leads to over-saturation of agricultural products with harmful to human substances.

In order to find a way out of a crisis situation, it is necessary to develop and use a new type of fertilizer - drugs that enrich the soil with microflora: mushrooms, bacteria that affect its fertility, as well as the introduction of a new direction in agrobiological science - biotechnology of humus. For regeneration of soils, fertilizers use vermicompost (biohumus) [2, 3] – the product of processing organic matter (waste animal complexes, organic waste). Studies have established that

biohumus has a multifaceted positive effect on agrochemical, physico-chemical, and biological properties of soils. In a biohumus accumulated a large number of macro- and micronutrients that are directly absorbed by plants. There are a number of growths, vitamins, antibiotics, 18 amino acids and useful microflora. Humic preparations are environmentally inert, therefore, they are increasingly used as soil structurants, as well as for solving environmental problems, in particular for controlling groundwater contamination by chemicals (herbicides, heavy metals, etc.), to reduce their input into crop production.

One of the most important trace elements is cobalt. The main physiological role of cobalt is to increase the activity of various enzymes, which are the catalysts of many processes in plant organisms. Investigated that cobalt has a positive effect on the accumulation of chlorophyll, increases its resistance to destruction in the dark, increases the strength of the chlorophyll-protein complex.

Cobalt is a constant part of the animals and humans blood. This element plays an important role in oxidation-reduction processes, the metabolism of carbohydrates and fats, increases the use of aminoacids for the synthesis of proteins by the body [4].

With a significant lack of cobalt in animals, growth and development of the organism are delayed. However, excess amounts of cobalt are undesirable, since in this case the immunobiological reactivity of the organism decreases, conditioned reflex activity is violated, the hematopoietic organs are affected. Cobalt in soils is scattered in various compounds, the degree of availability of which is unequal for plants [1]. Soil soluble Cobalt salts can be subjected to fixation due to the formation of insoluble oxides, sulfides, phosphates, carbonates, etc. All this can lead to the fact that seemingly optimal doses of cobalt fertilizers may not be sufficient to feed crops. The effectiveness of complex and complex-mixed

fertilizers containing Cobalt depends largely on its mobility in fertilizer and soil, as well as on resistance to soil fixation.

Nowadays, the influence of complex microelements compounds on plants development is effective in agrochemical practice. The use of chelated polyethylene polyamine acetic acid has made it possible to achieve great success in the fight against calcareous chlorosis [1]. The work [3] shows a sharp increase in the intake of a micro element in the plants of the wiki and oats due to high mobility $[CoEDTA]^{2-}$ in the soil profile. Presowing treatment of seeds of maize, sugar beet, cotton with ammonia complexes Cu, Co, Mn gives significant yield increases [4]. Some of the currently used macrofertilizers - NH_4OH, $CO(NH_2)_2$, as well as promising highly concentrated fertilizers based on polyphosphates, phosphonitriles, phosphamides, etc., have a complexing ability. An investigation of their interaction with Co^{2+} is of considerable interest. Complex ions of cobalt depending on their nature, strength and steric characteristics, apparently, will be transferred to different degrees and fixed in the soil profile.

Chelate formation of Cobalt with organic polydentant ligands to some extent simulates many natural processes. Complexes of this type are sufficiently stable and can be used as independent micro fertilizers or in combination with macro components. To determine cobalt in soil, the following analytical methods are recommended (with detection limits, mg / kg):

- the method of optical fluorescence analysis (OFA) allows to control up to 15 metals with a sensitivity of $1 \cdot 10^{-3}$ mg/kg to $1 \cdot 10^{-1}$ mg/kg and a relative error of measurements of 5 - 30%;

- spectrophotometry in the visible, UV and IR regions of the spectrum;

- atomic absorption and emission

- fluorescence spectroscopy ($1 \cdot 10^{-3}$ - $1 \cdot 10^{-6}$).

The disadvantage of these methods is the high cost of appliances and chemical reagents, rather complicated maintenance, the presence of specially equipped facilities and high-quality service staff [7];

- electroanalytical (voltammetry, polarography, potentiometry, electrochemical inversion analysis - inversion voltammetry and chronopotentiometry ($1 \cdot 10^{-4}$ - $1 \cdot 10^{-5}$) [5-7].

The most simple, highly accurate new electrochemical method of pulsed inversion chronopotentiometry with the use of the advanced analyzer of heavy metal salts "M-XA1000-5" is proposed for research. The principle of its work is based on the basic method of inversion chronopotentiometry (IChP method) [8-11]. At the heart of the basic method of IChP is the electrochemical concentration on the indicator electrode of the element that located in solution and its subsequent electrical dissolution in the voltamperostatic regime at a given resistance in the circuit that regulates the speed of the process in the reaction:

$$Me^{n^+} + ne \underset{\varphi_i}{\overset{\varphi_k}{\Leftrightarrow}} Me \qquad (1),$$

where n - valence of metal.

The main analytical functions of the method are the time of inversion or the transition metal oxidation time (τ_i), which under constant conditions of electrolytic concentration and electrooxidation is proportional to the metal concentration in the solution C_{Me}^{n+}, as well as the inversion potential - is a qualitative characteristic of the metal, which is determined in the experiments. The main criterion equation IHP has the form:

$$\tau_i = \frac{nFDSRC_{Me^{n^+}}}{\varphi_i \delta} \tau_k \qquad (2)$$

where τ_k – time of electrolytic deposition of metal ions, F - Faraday number; D - diffusion coefficient and concentration of ions in the solution of Me^{n+}, S, R -

the surface of the indicator electrode and the specified resistance in the oxidation chain, φ_i - inversion potential, δ - the thickness of the double electric layer;

where:

$$\frac{nFDSR}{\varphi_i \delta} = const = K \quad (3),$$

$$\tau_i = KC_{Me^{n+}}\tau_k \quad (4).$$

From the given criterionic equation of the method of the IChP it is evident that the basic electrochemical parameters that determine the sensitivity of measurements are R and τ_k. Unlike other electrochemical techniques, the method of IChP due to large values of R (20-150 kOm) has high protection against accidental interference, practically not sensitive to capacitive currents, which allows the use of a wide range of indicator electrodes (Ei) [8, 11]

As comparative electrodes (Ec), most widely used are calomelic and chloro-silver, the resistance of which is much smaller than R. The IChP method does not require a three-electrode electrochemical cell, since in the concentration cycle Ec acts as an auxiliary electrode, and in the cycle of electrochemical inversion it is a comparative electrode.

Since the simulation of natural systems is associated with great difficulty and, in some cases, impossible at all, for the more objective information on the content of the heavy metal in such systems, it is proposed to use the method of standard addition.

The analysis results are calculated according to the equation:

$$C_{Me^{n+}} = K_n \frac{\tau_x \cdot m}{\tau_{x+m} - \tau_x} \quad (5)$$

where, τ_x - inversion time before adding an additive; τ_{x+m} - time of inversion after the addition, m - weight of additives, K_n – translation coefficient of the contents of the heavy metal in the traditional dimension (introduced into the program).

The experimental part. The experience of applying the basic method of IChP for the determination of concentrations indicates that it is almost impossible to further increase the sensitivity of the measurement and increase the inversion time with this method, therefore, it is proposed to apply known principles of pulsed electrochemical methods of analysis for solving this problem. Pulse methods are widely used in voltammetry, the theoretical foundations of such an approach are described in the papers [11] and others.

The basic idea of using pulsed methods in chronopotentiometry is to increase the inversion time by actively interfering with the electrolytic oxidation process [11]. During the momentum, the "charge" of the measuring electrode occurs, that is, the electrode transiently enters the concentration mode, which reduces the electromotive force of the oxidation, slows the inversion process and increases the sensitivity of the concentration measurement. The general scheme of the use of the inverse pulse mode at constant values of the pulse parameters and periodicity is given in Fig. 1.

The principle of the pulse inversion chronopotentiometry method (PIChP method) lies in the fact that, after electrochemical concentration, upon inversion, the rectangular pulses with one-sided amplitude increase over the current signal. The method makes it possible to increase the sensitivity of determining the concentrations of the elements up to 0,05 mmg/dm^3. The greatest effect from the application of the PIChP method was obtained in determining the trace amounts of concentrations of toxic elements: mercury, lead, cadmium, manganese.

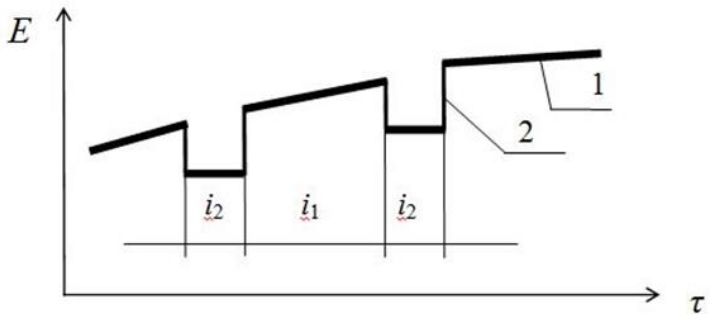

Fig. 1. General scheme of the use of pulse inversion mode:
1 - inversion signal, 2 - pulse, i_1 - duration between pulses, i_2 - pulse duration.

The essence of the PIChP method differs from the IChP method in that during the inversion, the values of a given level of metal dissolution are applied to the measuring electrode and rectangular pulses are applied to this signal with a constant increase in potential and duration in time.

Materials and methods. The first stage of the work was the use of the new PIChP method for determining the concentration of cobalt ions in soil samples and biohumus. For this purpose, electrochemical parameters (potentials of regeneration, concentration, inversion) have been experimentally developed and tested and background electrolates have been selected.

Before work, the working surface of a measuring gold electrode was ground with calcium sulfate chemically deposited, washed thoroughly with distilled water; The comparative electrode was filled with a solution of 2M HCl. The electrodes were immersed in a background solution of the electrolyzer, which was mounted on a magnetic stirrer. Measurements of Co(II) concentrations were carried out using standard additives in model solutions at a concentration of 1.0; 0.1; 0.01 and 0.001 μg/cm^3. Grading solutions at a concentration of 10.0 1.0 and 0.1 μg / cm^3

were prepared by diluting standard solutions of Co (II) (MSO 0137: 2000, DSO 022.78-98). Parameters of electrolysis on a gold electrode are given in Tab. 1 [12].

Table 1. Electrolysis parameters for measuring Co (II) concentrations in aqueous solutions

Electrolysis parameters	Co(II)
Regeneration potential, *V*	+0.050
Duration of regeneration, *s*	120
Electrolytic deposition, *V*	-1.4 ÷ -0.100
Resistance, *kOm*	150
Duration of concentration, s	15 - 210

Immediately before cobalt measurement, a background electrolyte was prepared which consists of a solution of A: (2M HCl + 0.1M NaSCN + 0.4M Na_2SO_3) and solution B: (4M NH_4OH) in a ratio of 3: 2.

For studies on the absorption of cobalt by soils from complexing media, soil samples were taken from a layer of 0-20 cm; Sample soil soda cortical solonetz - from a layer of 20 - 40 cm (Table 2).

For the first study, aqueous solutions of KNO_3, NH_4OH, and CSN_2H_4, which are used as ligands in agrochemical practice, were prepared. The experiments were carried out according to the following procedure: 10 g of air-dry soil was filled with 60 ml of a solution containing Co in an amount of 7 mg/kg soil and a corresponding ligand. The mixture was agitated for 1 hour on a rotator and filtered through a folded filter. In the filtrate, Co was determined. Analysis of Co from solutions containing KNO_3, NH_4OH, and CSN_2H_4, was performed by a new method of pulse inversion chronopotentiometry [11].

In the second series of studies, solutions of polyphosphates $Na_4P_2O_7$, $Na_5P_3O_{10}$ and Trilon B were prepared as a universal organic complexone (disodium ethylenediaminetetraacetic acid). Due to the fact that polyphosphate and trilonate Co complexes do not recover at the electrode in a favorable potential range (up to -

2.0 V), a special technique for their analysis was developed, consisting of the following: 20 ml of a solution of dithizone in $CC1_4$ from 20 ml of polyphosphate Co solution for 5 minutes at pH 8.8 (control with a pH meter «pH 150 M») [12].

The extract was washed with 10 ml of water to completely remove the phosphates and then in a glass was evaporated on the tile to the state of wet salts. The moist residue was mineralized by adding 1 ml of conc. HNO_3, 1 ml of 30% H_2O_2 and 1 ml of conc. H_2SO_4. The contents were heated until the appearance of sulfuric acid vapors and then 1 ml of H_2O_2 was added once more. Trilonate solutions were burned dry without pretreatment with solutions of concentrated acids. The residue was dissolved in 2M NH_4OH and Co determined by the IIHP method using a gold solid-solid electrode [12, 13].

In the third series of studies, 100 g of biohumus were saturated with cobalt ions in active contact with a 0.5 M solution of $Co(NO_3)_2$ for 48 hours. The solid phase was filtered, washed to a negative reaction to ions NO_3^-, dried in air. The obtained samples were used to study the extraction of cobalt ions from biohumus by solutions of 1M $CaCl_2$; 1M CH_3COONH_4; 1M HCl; 0.02M Na_2EDTA + 0.09M NH_4Cl, which are common in agrochemical practice for the diagnosis of digestible forms of cobalt in soils. The maximum permissible concentration of moving cobalt forms in the soil is 12 mg/kg [13].

Results and its discussion. The obtained electrochemical parameters for determination of Co (II) on a gold electrode with background electrolyte A: (2M HCl + 0.1M NaSCN + 0.4M Na_2SO_3) and solution B: (4M NH_4OH) in a ratio of 3: 2 are given in Table. 1.

As an example (Table 2), the results of measuring the Co (II) concentration in model solutions are given and it is established that the limit of the absolute error

in measuring the cobalt concentration does not exceed ± 0.2C, the relative measurement error as a function of concentration varies from 2 to 18% Table 2).

Table 2. Accuracy of measurement of Co (II) concentration in model solutions (n=5, P = 0.95)

Measurement parameters		Co (II) is determined from the results of measurements, *mg / dm*^{3}
Indices	Concentration of Co (II) in solution, *mg / dm*^{3}	
The specified and measured Co (II) concentration in the model solution, *μg / cm*^{3}	1.0	0.98±0.08
	0.1	0.093±0.006
	0.01	0.0089±0.0005
	0.001	0.00082±0.0001
Relative error of measurement,%		2.0 – 18.0

This indicates that the method for determining the concentration of Co (II) according to the developed method of performing measurements by the method of pulse inversion chronopotentiometry in aqueous solutions can be used in a wide range of concentrations from 0.001 to 1.0 mg / dm^3 with high accuracy [12].

Table 3. Comparison of Co (II) mass measurement results in sod-podzolic soil by various analytical methods, mg / kg, (n = 5, P = 0.95)

Ion	The PIChP Method				Method Atomic Absorption Analysis			
	Sam. 1	Sam. 2	Sam. 3	Aver.	Sam. 1	Sam. 2	Sam. 3	Aver.
Co(II)	1.28	1.21	1.18	0.067± 0.002	1.31	1.24	1.16	0.073± 0.004

As a result of the studies, a sufficient level of coincidence of the results of measuring the cobalt concentration in soil samples obtained by different methods of analysis was established. The obtained data testify to satisfactory accuracy and reproducibility of the results of cobalt determination under the proposed conditions, and the lower limit of the element determination according to the developed method is established at a level of $1 \cdot 10^{-3}$ μg/dm^3.

In connection with the above, we studied the sorption of complex cobalt-containing ions by different soils. Based on the obtained data, the percentage of absorbed Co (II) was calculated (Table 4).

Complexity of Co in all cases is close to 100%. In solutions of KNO_3, NH_4OH and CSN_2H_4, cobalt is included in the complex cations $[Co(H_2O)_n]^{2+}$, $[Co(NH_3)_n]^{2+}$, $[Co(CSN_2H_4)_n]^{2+}$, , and in solutions $Na_4P_2O_7$, $Na_5P_3O_{10}$ and $EDTA^{4-}$ formed anionic complexes $[Co(P_2O_7)_n]^{2-4n}$, $[Co(P_3O_{10})_n]^{2-5n}$ and $[CoEDTA]^{2-}$.

Table 4. Absorption by soils from complexing media,%

The soil	KNO_3, 1M pH 7.9	NH_4OH 1M pH 11.8	CSN_2H_4 1 M pH 7.6	$Na_4P_2O_7$ 0,15 M pH 9.2	$Na_5P_3O_{10}$ 0,25 N pH 8.6	0,1 M EDTA pH 4.5
Chernozem-meadow solonchakous	97.7	92.7	83.6	58.0	50.7	4.8
Sod-medium podzolic	89.0	97.0	80.8	65.0	49.3	1.2
Dark chestnut solonetsous	93.6	80.6	85.3	20.5	14.2	2.8
Meadow solonetsous	97.6	95.7	89.8	62.5	62.5	7.5
Dark gray podzolized	97.7	92.6	95.5	51.3	43.6	6.9
Soda crust solonetz	98.1	97.9	89.5	48.1	43..0	4.8
Black soil southern low-humus	98.0	88.0	88.6	50.0	15.5	3.1
Gray podzolized	89.7	64.4	70.1	37.0	9.8	6.5
Podzolized black soil	97.3	93.5	82.1	58.4	55.0	4.8
Powerful chernozem	97.3	96.9	82.1	54.7	39.2	1.9

A high percentage of absorption of complex cations can be explained mainly by the cationic function of the soil absorbing complex. With increasing sizes of ligands in the series H_2O <NH_3 <CSN_2H_4, the dimensions of complex ions increase and, regardless of the specific soil, the sorption effect decreases.

In the case of cobalt-containing complexes of anionic character, the sorption effect is a function of the strength of complex ions. Pyrophosphate complexes (pK = 6,1 – 7,2) and tripolyphosphate (pK = 6,6 – 6,89) [9] are sorbed much more soils than trilonate soils, which is in accordance with high strength [EDTA] $^{2-}$, (pK = 16.1) [13-19].

To evaluate the biohumus capabilities as a cobalt carrier matrix, it was previously saturated with cobalt ions in active contact with 0,5 M $Ca(NO_3)_2$ solution for 48 hours (Table 5).

Table 5. The amount of cobalt that has passed into a solution of biohumus

Extractor	The amount of cobalt transferred to the solution of biohumus, *g/kg*
1H $CaCl_2$,	3.15
1M CH_3COONH_4	7.45
1M HCl	21.70
0,02M Na_2EDTA + 0,09M NH_4Cl	17.23

Conclusions. The cationic complexes of cobalt - $[Co(H_2O)_n]^{2+}$, $[Co(NH_3)_n]^{2+}$, $[Co(CSN_2H_4)_n]^{2+}$ - are almost completely sorbed by soils. Anionic complexes $[Co(P_2O_7)_n]^{2-4n}$, $[Co(P_3O_{10})_n]^{2-5n}$ and [Co EDTA]$^{-2}$ – remain largely mobile in the soil profile .The sorption effect depends on the charge of complex ions, their strength, and also on the steric parameters of complex ions.

The use of complex-forming macrofertilizers is promising, in our view, not only to partially prevent the fixation of Co, but also from the point of view of its possible activation from fixed forms in the soil profile. A comprehensive study of the behavior of Co in dependence on the parameters of the soil and the physiological characteristics of plants will, to a large extent, optimize the process of microelement nutrition of plants. In the study of biohumus, it was found that in a solution of 0.02M Na_2EDTA + 0.09M NH_4Cl, cobalt switches over to the mechanism of competitive complexation, and its transition to a HCl solution

occurs due to protonation of the functional groups of the biohumus with which the metal is bound.

The obtained results indicate that the biohumus has rather high collecting properties relative to cobalt and may be promising for its use as an effective carrier matrix in various combinations with basic fertilizers.

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Economic sciences

THE BULGARIAN MINING INDUSTRY IN 2020: SITUATION AND TRENDS

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Abstract. *The study presents the main key indicators of the Bulgarian mining industry for the period 2015 ÷ 2020. The purpose is to analyse the available statistical economic and market information and, thus, to outline the current state and trends for the development of the Bulgarian mining companies under the conditions of increased mining of metal ores and concentrates, due to: the increased demand for terminal metals, mainly on the European and world markets, the declining domestic consumption of steam coal, and the shrunk but increasing domestic consumption of construction and rock-lining materials and of industrial minerals. The methods used in the study are statistical and graphical methods of data analysis. The trends in the variation of key economic indicators generated by*

the global, the American, the European, the Chinese, and the Bulgarian economies for the period 2007 ÷ 2020 are outlined. A prognosis of the International Monetary Fund for 2021 and 2022 is made. A brief review is offered of the characteristics of the external and internal business environment in Bulgaria in 2020 in terms of the epidemiological situation caused by the COVID-19 infection. The fluctuations in the volumes of the Bulgarian industrial production for 2008 ÷ 2020 are analysed, along with those in the production prices for the "Industry" sector of the economy, for the "Mining and Quarrying Industry" sub-sector, for coal mining, for the mining of metal ores, and for the mining of non-metallic minerals and raw materials. Consequently, the conditions and perspectives of mining companies for the production and processing of coal, metal ores, and non-metallic minerals and raw materials are outlined. The prospects for the Bulgarian mining enterprises have remained optimistic due to the increased consumption of products for the chemical and food processing industries in Europe. Based on the non-renewable nature of mineral resources, the sustainable development of the world, the European, and the Bulgarian economies is impossible without an increase in their mining and consumption. This sets high requirements to the state, the municipalities, and the individual companies in Bulgaria in solving the tasks for long-term provision of the necessary energy, metal, industrial, and construction materials, the needs of which will continue to increase in the future.

Keywords: *mining and quarrying industry, economic activity, indices of industrial production, producer price indices, pandemic crisis, mining enterprises*

Introduction. According to the information officially published by the National Statistical Institute (NSI), and according to data by the INFOSTAT

information system of the NSI [15], given in Table 1, most of the Bulgarian mining companies currently achieve good production and economic results.

Table 1. Key indicators of the Bulgarian mining and quarrying industry

Source: INFOSTAT (NSI, 2021a), compiled by the authors.

Indicators	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Number of enterprises, num.	422	407	374	368	343	351
Number of persons employed, num.	24 862	23 963	21 843	21 522	19 022	20 086
Value of non-current assets, BGN'000	2 434 401	2 550 039	2 344 274	2 474 027	2 525 260	2 899 348
Expenses for the acquisition of non-current assets, BGN'000	268 144	316 336	215 267	356 812	728 318	n.a.
Operating income, BGN'000.	2 848 348	2 704 084	3 048 475	2 981 356	2 727 440	3 341 866
Operating expenses, BGN '000.	2 542 844	2 431 213	2 703 174	2 562 865	2 569 378	2 637 999
Financial result operating activities, BGN '000	305 504	272 871	345 301	418 491	158 062	703 867

According to the data in Table 1, 351 companies and organisations in the field of exploration, extraction, and processing of underground mineral resources and related activities and services were active in the mining industry in 2020. 20,086 people were directly employed in the industry, providing a little over 5% of the country's gross domestic product (GDP). Another 120,000 jobs existed to serve companies in this branch of the economy. The value of non-current assets exceeded BGN 2.8 billion.

Within the analysed period, the implemented financial result of the activity of the mining enterprises in 2020 has been the highest, namely BGN 703.9 million, formed by 3.3 billion levs in revenues and 2.6 billion levs in operating expenses.

It is worth noting that the number of enterprises and the number of employees in the mining industry subsector in 2020 increased compared to 2019,

but remained below the levels of previous years. The other key indicators realised by the mining industry for the entire analysed period in 2020 reached their highest value. The most significant of those indicators was is the growth of operating profit.

In recent years, the global, European, and much of the national economic systems have been recovering from one of the deepest recessions in modern economic history, namely the financial and economic crisis of 2008-2009. Concurrently, the corona virus epidemiological situation, which emerged in 2020, has severely reduced world production and consumption, leading to a collapse in the aggregate production of goods and services in 2020.

Over the last twelve years, the increased world production and consumption of metallic and energy raw materials has proved to be a favorable factor, initially for the development of the mining and processing of energy, metallic, and construction raw materials, as well as of some of the industrial minerals. Unfortunately, the sharp decrease in the consumption of building materials and of some of the industrial minerals in 2009 and 2010 is still posing limits to their extraction and subsequent processing [19]. The increase in the physical volume of construction, measured by the change in the index of construction output in Bulgaria in 2019 and 2020, determined the increase in the quarrying and processing of building and rock-lining materials during these years.

The purpose of this study is to analyse the available statistical economic and market information and, thus, to outline the current state and trends for the development of the Bulgarian mining companies under the conditions of increased mining of metal ores and concentrates, due to: the increased demand for terminal metals, mainly on the European and world markets, the declining domestic

consumption of steam coal, and the shrunk but increasing domestic consumption of construction and rock-lining materials and of industrial minerals.

The methods of analysis, synthesis, induction, comparison, as well as the graphical methods for analysis and presentation of the results of the analysis are employed in the research.

National and international organisations and their websites have been **the sources** of economic statistical information.

Economic activity of the world, the American, the European, the Chinese and the Bulgarian economies

Economic activity in 2020 declined and has remained at a relatively low level. The main reason for one of the most significant decreases in the indicators accounting for the economic activity in Bulgaria, namely the real gross domestic products, is due to the ambiguities in overcoming the ongoing epidemiological situation in this country and throughout the world as a result of the corona virus infection. The following factors have had an additional negative impact: the persisting fears for the financial health of some of the highly developed economies of the European Union (EU); Britain's exit from the EU; the still unresolved effects of the global economic crisis of 2009; the registered significant decline of the major EU economies; the high budget deficits and the growing public sector indebtedness. None of these factors could be overcome; moreover, there has been a steady trend towards deterioration.

Figure 1 presents the dynamics of change in real GDP of the world, the American, the European, the Chinese, and the Bulgarian systems of economy for the period 2007 ÷ 2020 and a forecast for the development of the indicator for 2021 and 2022. The figure is based on data from the annual reports of the

International Monetary Fund (IMF) for the period 2009 ÷ 2021 [1, 2 , 3 ,4 , 5 ,6 ,7 ,8, 9, 10, 11].

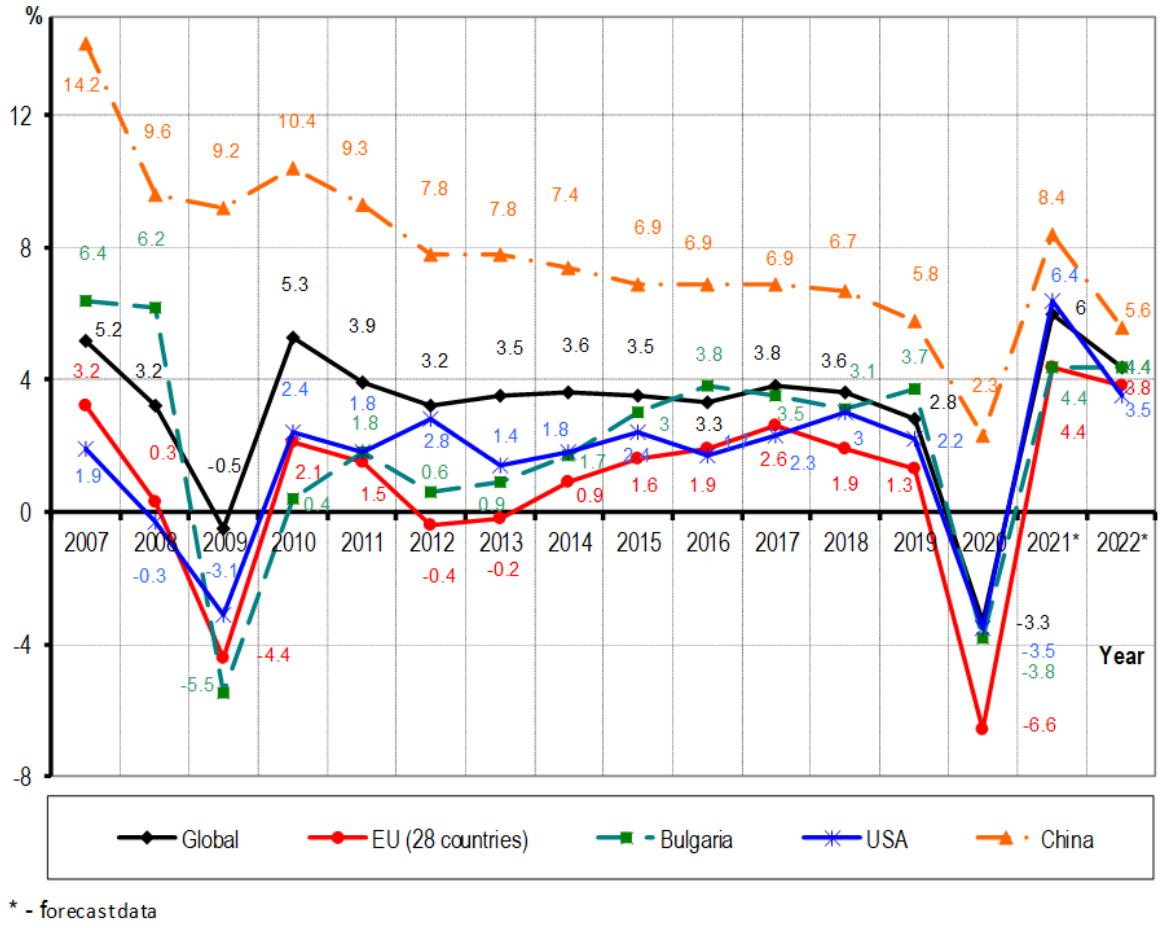

Figure 1. Dynamics of the real GDP change in the Global, the American, the European, the Bulgarian, and the Chinese systems of economy for the period 2007 ÷ 2020 and projections for 2021 and 2022

Source: IMF (2009÷2021), compiled by the authors

The graphical presentation of the data in Figure 1 reveals that in recent years, the rates of economic activity in Bulgaria have been close to those of the world as a whole, and higher than those of the USA and the EU. The significant difference from economic activity in China is quite understandable. For many, this information might sound reassuring; yet, the purchasing power and living

standards in Bulgaria have remained relatively low. Moreover, the forecasts for the development of real GDP of the various global, European, and national financial institutions, shown in Figure 1, are not unambiguous and are characterised by very high dynamics and uncertainty. However, they project the expectations of financial experts for the future development of individual systems of economy, which are subsequently subject to repeated inspections over certain periods. The low level of predictability of the development of the systems of economy is mainly due to the ambiguities in overcoming the corona virus epidemiological situation and the cyclical easing and tightening of restrictive measures that hinder the growth of economic activity and world consumption.

The decline in Bulgaria's real GDP for 2020 was 3.8%. The European Commission (EC) and the IMF forecast that in 2021 and in 2022, Bulgaria's economic growth will reach 4.4%. The decline in real EU GDP in 2020 reached a record level of 6.6%. The EC has forecast that the real GDP growth for the entire European Union is going to be 4.4% and 3.8% for 2021 and 2022, respectively.

The situation with the US economy is similar. In 2020, it achieved a record decline in real GDP of 3.5%, and the forecasts for the real GDP growth in 2021 and 2022 are for 6.4% and 3.5%, respectively.

The decline in the real GDP of the global economy in 2020 reached a record level of 3.3%. The IMF has forecast that the real GDP growth for the world economy will be 6.0% and 4.4% for 2021 and 2022, respectively.

In October 2021, the World Bank (WB) raised its forecast for the Bulgarian economy for 2021. The international institution has pointed out that the country's GDP is going to grow by 3.7% in 2021. In comparison, the WB's forecast as of June 2021 was for a growth of 2.6%.

Of course, all these forecasts of global financial institutions have a very high degree of uncertainty while the corona virus epidemic is not overcome yet worldwide; after that, an increase in global consumption can be expected that is the main driver of economic activity.

Bulgaria's external and internal economic environment in 2020

In 2020, Bulgaria's economic environment was characterised by high uncertainty and limited economic activity, mostly in the services sector where the consequences of the epidemiological measures were most drastic.

In 2020, the economic downfall of the world economy was by the record 3.3% compared to 2019. Against the background of the outbreak of the corona virus infection, the expectations of both business and consumers have remained moderately pessimistic. In the short term, both the measures taken to curb the development of the corona virus infection which has virtually closed or curtailed entire sub-sectors of the economy, as well as the record slowdown in the Chinese economy which is expected to slow the recovery of the global economy even in the medium term have had an adverse effect.

For most of 2020, the world's economic activity remained at a relatively low level. This was influenced by the spread of the corona virus infection which led to a slight decrease in the prices of the major commodities, incl. of energy sources and the weak growth of 2.3% of the Chinese economy as the largest consumer of resources and exporter of intermediate and end products.

At the national level, there have been significant changes in the economic policy of Bulgaria. It has continued to be rather passive to what is happening in Europe and in the world. Ultimately, the financial year 2020 can be defined as a year of a 3.8% decline in the real GDP and a tight fiscal policy. In these conditions, the survival of the business and the preservation of the assets turned into the main

task for the majority of the private, municipal, and state companies, as well as of the households. Domestic consumption in the country, which is essentially the main driving force of the economy, has shrunk due to the anti-epidemiological measures taken and the still weak purchasing power of the population. The social measures taken by the government as well as the schemes to support businesses and the population have failed to have a significantly beneficial effect on domestic consumption.

According to data by the NSI, in 2020, the average annual gross wage amounted to BGN 16,642 recording an annual growth of BGN 1,433 or 9.4% which, against the background of the low unemployment rate for the year that increased by 0.9%, led to a slight increase of household incomes and to restrictions in the domestic consumption [15, 16, 17, 18].

According to data by the NSI, in 2020, Bulgaria's exports shrank by 6.4% compared to 2019 and amounted to BGN 54.7 billion at FOB prices. Bulgaria's main commercial partners were still the EU countries, including the United Kingdom and they all accounted for 67.9% of the country's export. Bulgaria's 2020 import shrank by 8.9% compared to that in the previous year and amounted to BGN 60.1 billion at CIF prices.

In 2020, Bulgaria's foreign trade balance (export FOB - import CIF) traditionally continued to be negative and amounted to 5.5 billion levs which is a 28.3% decrease compared to 2019. The volume of goods exported to Germany, Romania, Italy, Greece, Turkey, France, Belgium, China, the Netherlands, and Poland was with the largest value. The largest value of goods from import was that from Germany, Romania, Turkey, Italy, Russia, China, Greece, the Netherlands, Hungary, and Poland [15, 16, 17, 18] was with the largest in value. In 2020, Germany persisted as Bulgaria's main commercial partner.

Indices of industrial production in Bulgaria

Figure 2 presents the indices of industrial production in Bulgaria for the period from the first quarter of 2016 to the first quarter of 2021 for the "Industry" sector, the "Mining and Quarrying" sub-sector, for coal mining, for the mining of metal ores, and for the extraction of non-metallic minerals and raw materials. The figure is based on data by the NSI [17] and the monthly data are revaluated on a quarterly basis.

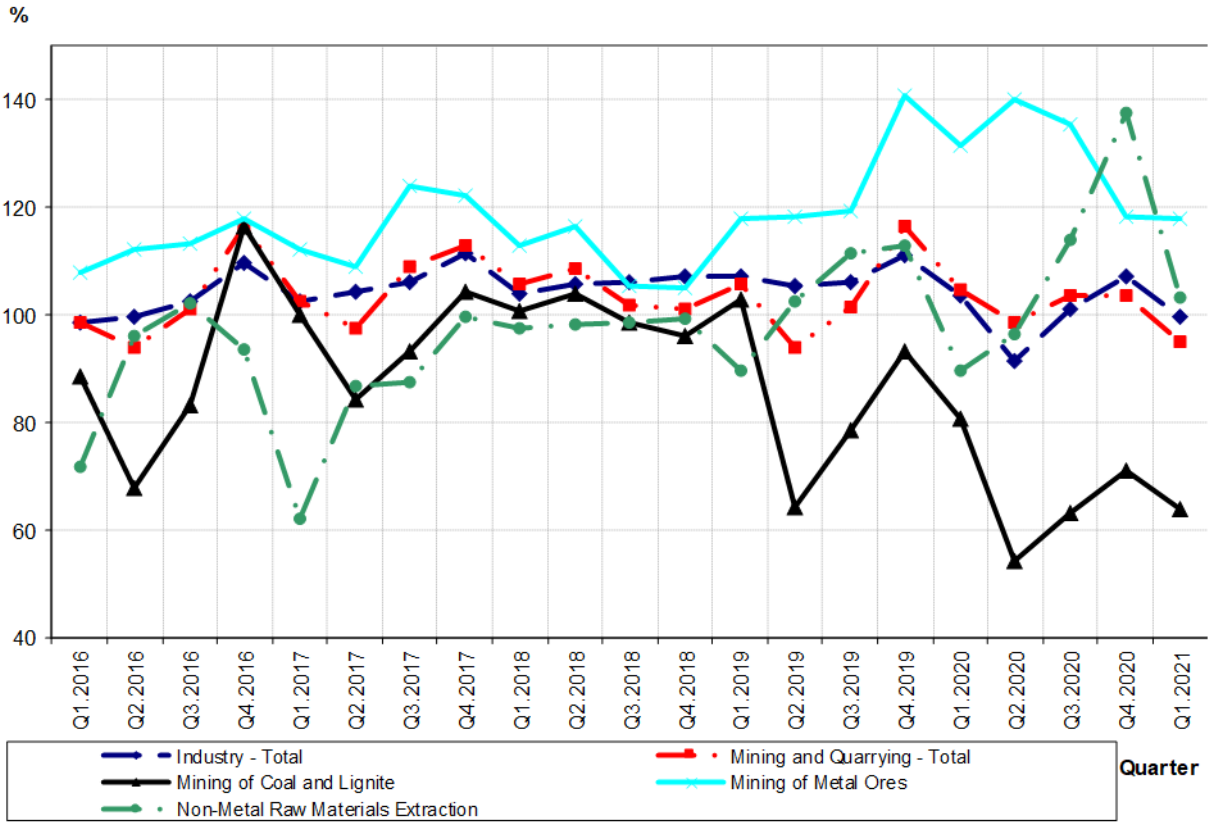

Figure 2. The quarterly industrial production indices in Bulgaria for the period first quarter of 2016 ÷ first quarter of 2021 for the “Industry” sector, the “Mining and Quarrying” sub-sector, for the mining and processing of coal and lignite, metal ores, and non-metallic minerals (seasonally unadjusted, 2015 = 100%)

Source: NSI (2021c), compiled by the authors

Figure 2 shows the slight growth realised by the industrial production of Bulgaria from the beginning of 2016 to the beginning of 2020. It is characterised by a slight seasonality and has already reached the levels before the onset of the financial and economic crisis of 2008-2009.

Coal mining in the fourth quarter of 2016 is marked by a steady decline with a strong seasonality. The decline is most obvious in the second quarter of 2019. This can be attributed to the decrease in the percentage of electricity produced from coal outside the heating season. Compared to the first quarter of 2019, t he decrease in the second quarter of 2019 reached 38 %. The obvious tendency towards seasonality in the production and consumption of electricity from coal in Bulgaria has continued.

In the period 2016 ÷ 2020 the mining of metal ores was marked by a significant growth with the only exception in 2018. The dynamics of the volumes of mining and sale of metal ores in each quarter of the period analysed has not been subject to certain seasonality, but has resulted from the fluctuations in the consumption and mining of metals worldwide.

The mining of building and rock-lining materials for the period has been relatively constant, with only a weak seasonality, and the trend during the period under analysis has been one of a moderate increase due to the increased volume of construction activities.

The change in the indices of industrial mining of non-metallic minerals and raw materials has also displayed a strong seasonality in their production and consumption, with sharp declines in winter months and with a rise in the other periods.

Overall, the industrial production in the mining industry in 2020 was characterised by a moderate decline compared to the previous 2019, which is the

result of the significant dip in the mining of coal and metallic minerals. During the fourth quarter of 2020, the mining of minerals decreased by 14 % compared to that in the fourth quarter of 2019.

Producer price indices in Bulgaria

Producer price indices reflect the dynamics of production and consumption on the market of minerals. In the presence of a stable rate in the change of producer prices in several consecutive periods, such a rate can be considered as an early indicator of the direction of movement of an individual branch of the economy or of the entire system of the economy. As a major short-term business indicator, this rate offers guidance as regards the trends in the development of consumer inflation (or deflation).

Figure 3 presents the producer price indices in Bulgaria on the domestic and international markets for the period from the first quarter of 2016 to the first quarter of 2021 for the "Industry" sector and the "Mining and Quarrying" sub-sector; for coal mining and the mining of lignite; for the mining of metal ores; and for the mining of non-metallic minerals and raw materials. The figure is based on data by the NSI [18] and the monthly data are revaluated on a quarterly basis.

Figure 3 shows that the average producer prices in the “Industry” sector during the period analysed increased by 12%. From 2016 to the fourth quarter of 2020, there was a significant increase of 20% for the “Mining and Quarrying” sub-sector, which is mainly due mainly to rise in price of metals and of non-metallic minerals and raw materials.

Producer prices for the mining of metal ores in 2020 were marked by a sharp increase of 22%. Here, producer prices were characterised by relatively higher fluctuations than those of the other types of mineral resources.

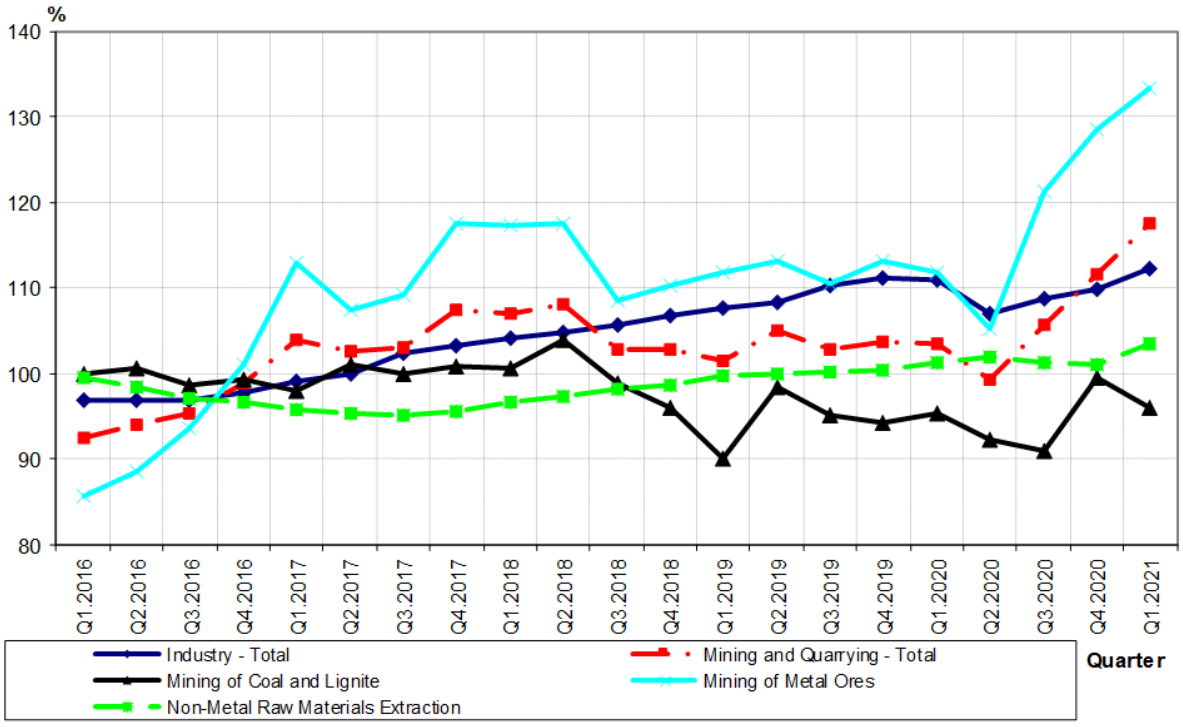

Figure 3. The quarterly producer price indices in Bulgaria for the period first quarter of 2016 ÷ first quarter of 2021 for the "Industry" sector, the "Mining and Quarrying" sub-sector, for the mining and processing of coal and lignite, metal ores, and non-metallic minerals (seasonally unadjusted, 2015 = 100%)

Source: NSI (2021d), compiled by the authors

Producer prices for the mining of coal and lignite in the period 2016 ÷ 2020 slightly declined by 5% due to the 2020 decline in energy prices and still shrunk electricity consumption. Coal prices have also been influenced by the prices of other energy sources, the high degree of state regulation, the prices of carbon emissions, and the long-term contracting of the supplies from two of the three thermal power plants from the East Maritsa Coal Basin.

There was a slight increase in producer prices in the mining of non-metallic minerals and raw materials. They were also characterised by very weak seasonality.

Producer prices of construction and rock-lining materials during the analysed period were characterised by a moderate increase. In 2020, they went sharply up as a result of the rise in the construction activity and the demand for new residential properties, due to high liquidity in the banking sector and the decrease in interest rates on the credits granted.

Conclusion. The data provided by the IMF and the NSI have clearly shown that in 2020 the Bulgarian economy was characterised by a real decline of 3.8%, and the prospects are for a moderate increase by 4.4% in both 2021 and 2022. The Bulgarian economy had an average annual inflation of 5.2% in 2020, an increase in the unemployment rate (from 4.2% in 2019 to 5.1% in 2020), with a growth of the gross average annual salary of 9.4% (from BGN 15,209 .in 2019 to 16,642 levs in 2020) and contracted domestic consumption.

The main factor for the economic dip of the Bulgarian economy in 2020 were the anti-epidemiological measures taken to overcome the corona virus infection, which limited economic activity, temporarily closing even entire sub-sectors like the “Services” one, which is this country’s largest sector. This resulted in the contraction of production, export, and import, to the withdrawal of foreign investment, and to rising prices in a period of limited domestic consumption.

The high dynamics of commodity markets and the ongoing economic instability determined the high levels of uncertainty about future development, which is why investors persistently limited their economic activity. It should be pointed out here that 2020 witnessed the withdrawal of some foreign investment from this country.

The rate of unemployment, wage levels, and the programs to support business and the population aggravated the country's social expenditures, as a

result of which expectations for a significant increase in domestic consumption have still been pessimistic.

The strong connectivity of the Bulgarian economy with those in the countries from Central and Southern Europe predetermines a high level of dependence of the Bulgarian economy on the development of economic activity in these EU regions.

The prospects for Bulgarian mining companies in the area of the mining and processing of metallic minerals have been favourable, due to the weak growth of production, but the rapidly rising prices of end metals in 2020. Owing to the predominant export nature of the produced concentrates and end metals, the long-term prospects for the production volume are tied to the expectations for the development of the European and world markets. The prices of metals, which were characterised by high dynamics and steady growth in 2020, have been retained at such levels that, in the short run, would favour their efficient mining.

The future mining of thermal coal is determined by the share of coal in the energy mix, as well as by the still limited domestic consumption of electricity, the weak seasonal growth of electricity exports, and the sharp price rise of carbon emissions.

Although the prices of thermal coal in 2020 went down, they remained at such levels that favoured their efficient mining, but only in open pits. The limited domestic consumption has restricted investment and has brought about a decrease in the volume of their mining.

The prospects for Bulgarian enterprises in the area of the mining and processing of industrial minerals, which were characterised by a significant growth in 2020, have remained optimistic due to the increased consumption of products for the chemical and food processing industries in Europe.

In the “Construction” sub-sector, 2020 saw a slight decrease in the output of building enterprises by 0.3% compared to 2019. It is expected to keep going rapidly up in the coming years. The consumption of building and rock-lining materials has remained way below the pre-2008 volumes, but the increase in the construction sub-sector is expected to continue in the long run. In the first half of 2021, there was a rise in the total number of construction permits issued for the erection of residential, administrative, and other building. The construction of new buildings already commenced has also gone up. These are all indicators of an expected increase in construction output in 2021 and of the corresponding rise in the production and consumption of building materials and aggregates.

Based on the non-renewable nature of mineral resources, the sustainable development of the world, the European, and the Bulgarian economies is impossible without an increase in their mining and consumption. This sets high requirements to the state, the municipalities, and the individual companies in Bulgaria in solving the tasks for long-term provision of the necessary energy, metal, industrial, and construction materials, the needs of which will continue to increase in the future.

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Pedagogical sciences

CRISIS MANAGEMENT FOR THE LITERATURE CLASSROOM DURING COVID 19 PANDEMIC EMERGENCY: A PROPOSAL UNIVERSITI SAINS MALAYSIA

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Abstract. *Coronavirus Disease (COVID-19) is an infectious disease, which has led to a negative impact in higher education where lecturers and students have had to conduct the teaching-learning process through the Emergency Remote Teaching (ERT). The focus in this study is crisis management in the Literature classroom during COVID 19 pandemic. In 2019, the face-to-face teaching took place in the Literature classroom for both semesters as Malaysia was in a normal condition. This method took place until February 2020. The lecturers had to switch to the Emergency Remote Teaching (ERT) suddenly as soon as the Movement Control Order (MCO) was announced in March 2020 due to the rapid number of cases. During this crucial phase, the Literature lecturers and students were worried because they had to adapt to a new learning environment, and they were not exposed to these kinds of teaching and learning. The Literature lecturers and students struggled during the first semester since remote teaching newly took place in the Literature classrooms. Literature is one of the most difficult subjects to learn remotely as it requires a lot of explanation for better understanding of the subject.*

The lecturers and students have had to struggle with ideas and technology in teaching and learning, as they had no experiences of remote teaching. With time, they have adapted to this method, and it has become a new normal for them. In this unexpected condition, it is very important to understand how technology mediated the education process and how the lecturers and students experienced the change brought by the pandemic. This research aims to understand the importance of technology and the way Literature lecturers and students adapted to Emergency Remote Teaching in the Literature classroom throughout this crisis.

Keywords: *COVID 19, higher education, Emergency Remote Teaching, crisis management, Literature, technology, Literature classroom.*

Introduction. On 31st December 2019, the Wuhan Municipal Health Commission in Wuhan City, Hubei province, China reported a cluster of pneumonia cases of unknown etiology and was noted to be different from previously known coronavirus infections that causes severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV). Inoculation of respiratory samples into human airway epithelial cells, Vero E6 and Huh7 cell lines, led to the isolation of a novel respiratory virus whose genome analysis showed it to be a novel coronavirus related to SARS-CoV, and therefore named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The global spread of SARS-CoV-2 and thousands of deaths caused by the coronavirus disease (COVID 19) led the World Health Organization to declare a pandemic on 12 March 2020. Due to this, COVID 19 had destroyed all types of fields especially in education. The impact of the pandemic was equally grievous in the higher education. Globally, 91% of higher education institutions reported that in-person teaching had been replaced or was in process of

being replaced, by remote activities (Marinoni et al., 2020). Literature is one of the subjects which is being taught in the higher education.

Since human-to-human transmission was identified shortly after Li XJ, Wang M & Chen CZ et al. (2020) positing that "considerable efforts to reduce transmission will be required to control outbreaks, all the institutions had to be closed. Due to this, the classical method of teaching which refers to the face-to-face teaching was cancelled, and it was immediately switched to the Emergency Remote Teaching (ERT). This is difficult for the Literature lecturers and students because Literature is a subject, which needs to be taught directly for a better understanding. Next, the Emergency Remote Teaching took place suddenly where test, assignments, projects and exams were conducted remotely. This is a trouble for the lecturers and the students because Literature subject requires a lot of creative writing. For instance, students are required to write an essay and elaborate their points whereas lecturers need to mark the exam sheets remotely. Other than that, internet connection is the biggest challenge faced by the lecturers and students as they might experience a poor internet connection during a remote teaching, and this is an issue, which happens very often. The teaching-learning process will not successfully take place if there is a poor internet connection as the lecturers are not able to teach and students could not learn. Fullan (2000) has argued that the purpose of education is to build learning communities. By having a bad connection, lecturers are not able to produce students who are willing to learn interestingly. Moreover, Covid 19 has created a huge gap between the lecturers and teachers to have an interactive lesson. This is said because, students' participation during remote teaching will not be active as how they were during the face-to-face teachings. Students were given the opportunity to demonstrate the tasks during the face-to-face teaching, which enhances their interest in learning. Remote teaching

makes students to feel bored as they only sit and focus on the lesson. So, this made the Literature lecturers to not have an interactive session with the students.

The struggle went on until the first semester was completed since it was the first experience for the lecturers and students towards remote teaching. In September 2020, it has become a new normal in the education field. Literature lecturers and students were almost adapting to remote teaching. It is not an issue anymore for the them as they have mastered everything remotely in the February and September semesters in 2021. Lecturers can conduct the lessons and mark exam sheets remotely whereas students have also adapted to answering exam papers and completing assignments and projects remotely. According to Al-Helou (2011), he declared that crisis management is an administrative approach to deal with crisis conditions and to prepare and plan of how to confront them, which is an administrative method that primarily depends on the ability to predict crises and develop scenarios for them through examining and diagnosing weaknesses in administrative organization and placing them under close supervision in anticipation of their explosion and the emergence of a genesis. Similarly, the Literature lecturers and students confronted this crisis by planning an Emergency Remote Teaching which is now a new normal in the Literature classroom during a lockdown. Therefore, the research objectives are based on the followings:

1) To identify the changes that were made to the Literature syllabus to adapt to the Covid-19 Emergency and remote teaching.

2) To identify the perception of the Literature lecturers towards the usage of technology during the Emergency Remote Teaching.

Literature review

Crisis Management

A crisis can be interpreted as an event that will have negative on the organization or the company (Fajar, 2011). COVID 19 is a crisis, which has harmed all the sectors including social, cultural, educational, political, legal and security. In this case, immediate action had to be taken to reduce the transmission. According to Smith (2005), she declared that crisis management is a treatment that must be done given the issues outside the control of the institution or company. This study is exploring on how crisis management took place in the education sector. Crisis handling consists of three stages, namely pre-crisis, crisis, and post-crisis (Sa'diyah, 2013). Pre crisis is defined as an initial effort that must be done by the institutions to collect data regarding the crisis and identify problems. Crisis defines as the handling stage in the form of implementing a programme strategy and post crisis aims to measure the process of implementing a crisis programme. Unfortunately, pre-crisis stage was not implemented in Malaysia because everyone was not aware of this pandemic. Immediate actions were taken when there was a tremendous increase in the number of cases in Malaysia. Malaysia is currently going through the crisis stage as the pandemic has not come to an end. Initially, Malaysia reported 22 cases in January 2020. With time, there was a rapid number of cases increasing and so many people were affected by this crisis. Due to this, the Movement Controlled Order (MCO) was announced on 16th March 2020. The Emergency Remote Teaching (ERT) took place in the education sector. This type of teaching is called distance learning activity or study from home. This type of teaching produces a lot of communication experiences. Experience is based on motives to produce different perceptions of reality (Nurtyasrini & Hafiar, 2016). Covid is the new reality which has affected the world and it had brought all the educators and students to a different phase of teaching. During the February 2020 semester, Literature lecturers and students were panicked as they did not have any

experiences towards Emergency Remote Teaching. This pandemic is new for adaption, and it creates a lot of experiences for them in terms of teaching and learning. Yet, they have successfully managed in overcoming this crisis by conducting an effective remote teaching. “Educators have a special responsibility to help students develop the creative thinking skills required to imagine the unimaginable events that lead to crisis” (Circa and Corrigall, 2010). Creative thinking is important and much needed during remote teaching as the lecturers need to prepare more questions related to higher order thinking skills (HOTS) which a level is higher than memorizing and more to application form. The role of the Literature lecturers was heavy and tough as they had to handle the teachings and guide the students on remote teaching. Also, the teachings which the lecturers conducted remotely resulted differently from the classical method of teaching.

Emergency Remote Teaching (ERT)

Emergency Remote Teaching (ERT) is a temporary shift of instructional delivery to an alternate delivery mode due to crisis circumstances. It involves the use of fully remote teaching solutions for instruction or education that would otherwise be delivered face-to-face or else hybrid courses and that will return to that format once the crisis or emergency has abated. Instead of recreating an educational ecosystem, this teaching provides temporary access to instructions and instructional supports in a manner that is quick to set up and is reliably available during an emergency or crisis. By having the concept of ERT in mind, it helps to divert students’ responsiveness towards the virtual world and discuss the real-life lessons through freestyle on the ongoing suspension. The Emergency Remote Teaching took place in the Literature classroom with the help of technology during Covid 19. The ability to use technology to teach learners at distance has been especially important in times of emergency such as natural disasters (Joshi et al.,

2018; Rush et al., 2016) and extreme violence (Ramadan, 2017). Similarly, technology has helped the lecturers and students to conduct this Emergency Remote Teaching. Despite having connection problems, they have successfully managed to complete a few semesters remotely. Zoom, google classroom and Cisco Webex are some examples of educational platform which lecturers uses to conduct the Emergency Remote Teaching. Literature lecturers shares their screen which shows the slides of the lessons to the students to ease the teaching-learning process. To establish the social presence, we incorporated several asynchronous activities, including online discussions and peer feedback (Lowenthal & Snelson, 2017). Synchronous learning is learning that happens at the same time for the instructor and the learner whereas asynchronous learning is a learning where the instructor and the learner are not engaged at the learning process at the same time. Lessons, test, and final examinations are synchronous as the Literature lecturers and students interacts with each other at the same time. Assignments and project are asynchronous as students can spend their time to complete the tasks. Emergency Remote Teaching made lecturers and students to handle this crisis smoothly.

Literature Syllabus

Literature refers to the study of text around the world which is written in the English language. Literature components like poems, short stories, novels, and drams are known as the main elements in a Literature syllabus. However, other types of texts such as screenplays, songs, and lyrics could be considered as Literature depending on the terms in understanding the context. A Literature syllabus contains topic related to this type of texts and learners are assessed in their assignments, project and examinations based on these topics in higher institutions. During the face-to-face teaching, it was easy for the lecturers to conduct the

lessons since they were able to meet the students physically. In fact, they could use projector and screens together with laptops to teach. So, they could assign collaborative learning tasks such as role play, drama competition and talk show to assess the students based on the Literature topics. Unfortunately, the syllabus and assessments had been modified by the Literature lecturers according to the mode of teaching due to the pandemic. This pandemic also created some changes in Literature classrooms where most of the institutions prefers take-home assignment and examinations since students are unable to conduct live presentations. However, the modification done by the lecturers has made students to have a better understanding in the syllabus and they managed to complete the assessments successfully.

Information and communication technology (ICT) in Education

Information and communication technology (ICT) in education is the mode of education that use information and communications technology to support, enhance, and optimise the delivery of information. During this crisis, the usage of ICT has become the primary tool in the education system. The rapid evolution of Information Communication and Technology (ICT) and the increasing complexity that comes with its exploding potential explains why integration of technology in education continues to receive special attention particularly, in wake of COVID-19 pandemic. Previous research undertaken by the author has revealed that students tend to have a strong bonding with ICT (Ali, 2018). In this critical situation, the lecturers also tend to have a strong bonding with the ICT as they must conduct the whole semester using technology. The Emergency Remote Teaching could only be conducted with the help of ICT. For instance, laptops, tablets, iPad, smartphones, and computers are some examples of technologies which are being used by the lecturers and students for the remote teaching. Moreover, educational platforms

such as google meet, google classroom, Cisco Webex, zoom could only be assessed with the help of ICT and not to forget that assessments are also being prepared through ICT. In this case, ICT has helped the lecturers and students to know more about technology and prepare them towards any circumstances which may happen in the future. It is not a trouble for them anymore as they have mastered implementing ICT in the remote teaching in supporting the teaching-learning process in the Literature classroom. ICT has also encouraged the Literature lecturers and students to have a strong collaboration with each other. The Literature lecturers could use different apps and trusted online resources enhance the teaching-learning process and keep students engaged in a lesson. So, this pandemic has proven that ICT has played a very important role in the education system.

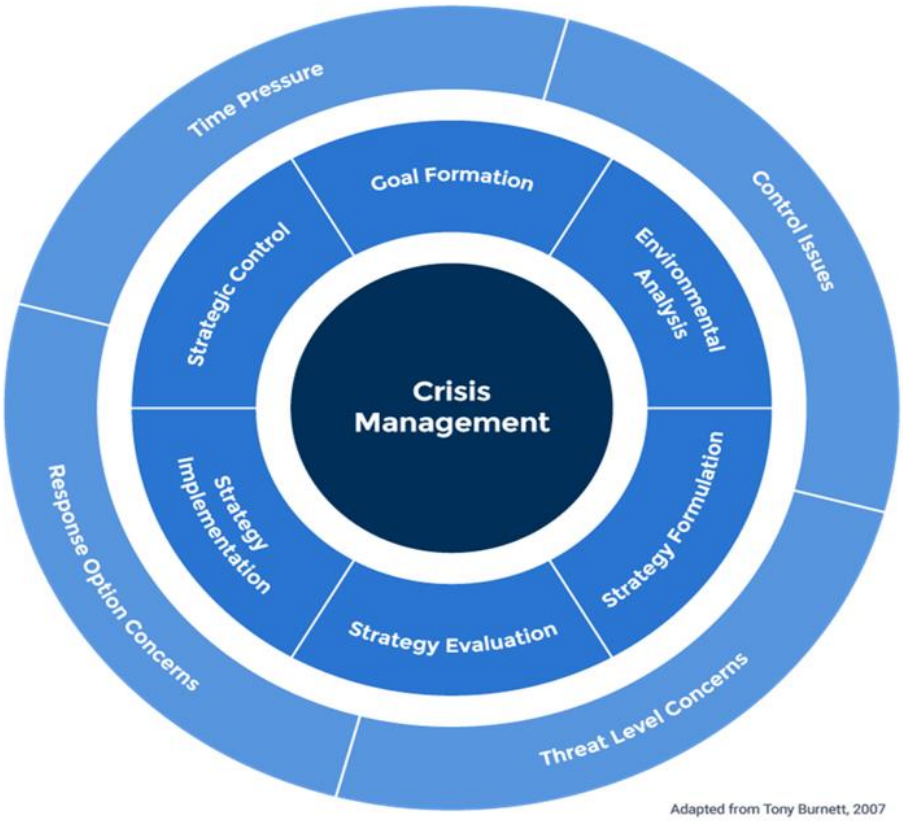

Fig.1. Burnett's Crisis Management Model

Burnett's crisis management model shows the steps taken by the Literature lecturers in overcoming the crisis. The six steps in the inner circle explain the planning made by the lecturers in conducting the semester. It is important for them to have a goal to ensure that they know what is supposed to be taught to the students once the alternate mode of teaching is formed. The environment in higher institutions was much easier for the lecturers as it was the face-to-face teaching. Therefore, lecturers can assess the students by observing their four skills during live presentations. Since Covid-19 is a virus which transmits via human-to-human, it was not safe for the teaching and learning process to be conducted physically. Due to this, the higher institution planned an Emergency Remote Teaching (ERT), which is known as a temporary shift of an instructional delivery to an alternate delivery mode to reduce the spread of the virus. It involves the fully remote teaching solutions for instructions or education that would otherwise be delivered face-to-face or as blended or hybrid courses that will return to the format once the crisis has come to an end. The Emergency Remote Teaching could only be conducted with the help of technology and educational platforms such as zoom meeting, and google meet are implemented by the lecturers during lectures. Therefore, it is important for them to evaluate their strategy to ensure that the platforms used are appropriate and suitable to conduct the semester. Strategy implementation refers to the execution of the plans or strategies to accomplish the goal. Once the method of teaching is evaluated by the Literature lecturers, they start implementing this strategy in the Literature classroom. Strategic control involves monitoring and evaluation of plans, activities, and results with a view towards future action. If the lecturers notice any weaknesses during the remote teaching, then they should have improvement towards it. At the same time, it is important for the lecturers to get student's feedback to enhance the teaching-

learning process. The outer circle of this model shows the consequences which the Literature lecturers face during the Emergency Remote Teaching. They often have time issues during this crisis as they need to complete everything online within the time phrase given. Literature lecturers often face control issues due to the environment or the behaviour of another person. Family members might interrupt during the remote teaching. This situation might lead the lecturers to feel upset and they may not have an interactive lesson. Hacking activities, virus or malicious activities are some examples of cyber threat which often happens during a remote teaching. Literature lecturers should be aware of the attendees in the Literature classroom. Response option concerns refers to the concern of the potential answers that one provides to the people taking the survey. Literature lecturers should ask students' feedback once they conduct the remote teaching.

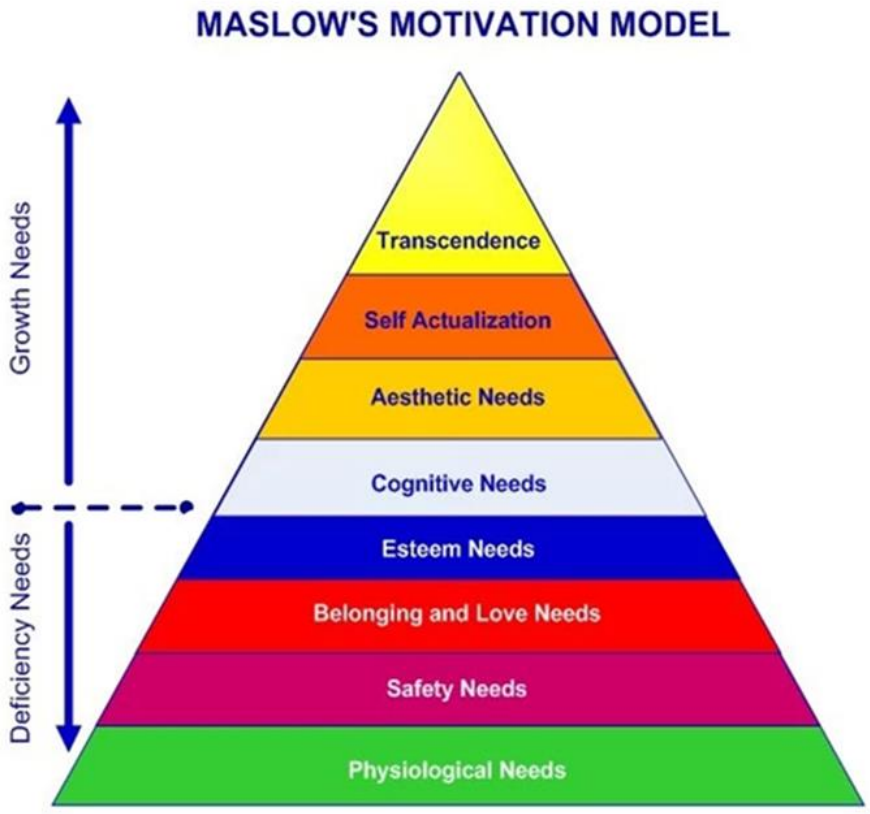

Fig. 2. Maslow's Hierarchy of Needs

Maslow's Hierarchy of Needs in this study shows how much of the needs for the Literature lecturers and students are achieved. This is a motivational theory that comprises seven-tier model of human needs which is also known as the hierarchical levels of a pyramid. Basic psychological needs are defined as "those nutriments that must be procured by a living entity to maintain its growth, integrity, and health". (Deci & Ryan, 2000, p. 326). Physiological need is important as the lecturers and students need sufficient food, air, shelter, drink, and sleep for them to conduct the remote teaching. Their bodies would not be able to function actively if they do not consume these main needs. Thus, the satisfaction of basic psychological needs should be given a priority, to ensure positively engaged and optimally motivated employees (Van den Broeck et al., 2008). The role of a lecturer is heavy as they need to prepare the input to make sure that students are on track. Safety need is also considered to be important because Covid-19 is a virus which transmits from human-to-human, and it is not safe for the Literature lecturers and students to conduct the face-to-face teaching in the Literature classroom. The proceduralization or bureaucratization of safety assessments may in fact hamper the kind of relational thinking that is necessary to see possible correlations that become relevant or critical in a crisis (Bieder and Bourrier, 2013). Due to this, the lecturers had to conduct the Emergency Remote Teaching during this crisis. Once safety need is fulfilled, the love and belongingness need must be achieved as human needs to love and be loved sexually and non-sexually by others. Higher institutions understand that the students and lecturers belong to them. At the same time, the Emergency Remote Teaching took place in the Literature classroom because the college and universities are concern about the lecturers and students. Most people have a need for a stable esteem, meaning which is soundly based on real capacity or achievements. Self-esteem is described simply as an

attitude, the evaluative component of self-concept (Gergen, 1965; Rosenberg, 1965). Although it is hard, the Literature lecturers and students have the confidence and strength to overcome this crisis by conducting the Emergency Remote Teaching. One has cognitive needs such as creativity, predictability, curiosity and meaning. People who enjoy activities that require deliberation and brainstorming have a greater need of cognition. Students are assessed mostly based on their creative thinking they are not able to conduct activities like role play and talk shows. Aesthetic needs are the next in the hierarchy of needs. According to Maslow's theories, human must connect themselves with the world's beauty to progress towards Self-Actualization. Modern technology offers many means in improving teaching and learning in the classroom. (Lefebvre, Deaudelin & Loiselle, 2006). As the lecturers and students gain experience during the remote teaching, they begin to appreciate the usage of technology. The impact of technology during the lockdown is huge as it makes the remote teaching to take place. This crisis had led the lecturers and students to realize their personal growth and self-fulfilment in overcoming this issue. They will not get panicked if anything like this crisis happens in the future. Covid 19 has taught the lecturers and students to overcome their stress management during a crisis. Initially, both the lecturers and students went through stress and depression due to the pandemic. Now, they have learnt how to manage a situation without having stress or depression.

Math Bower (2019) has stated that technology-mediated learning is used to imply that technology is the main source used to link people in conveying information. Affordances is defined in the relation between the user and the object. It is also known as what the user can do with an object with the user's capabilities. In this study, affordances refer to the relation between the Literature lecturer and students with technology. Technology is very important as the lecturers and

students used this medium to deliver and process information. For instance, when the lecturer prepares a lesson on a computer and places it online for later interpretation by students on their laptop or smartphones, the communication act is entirely facilitated through digital technologies.

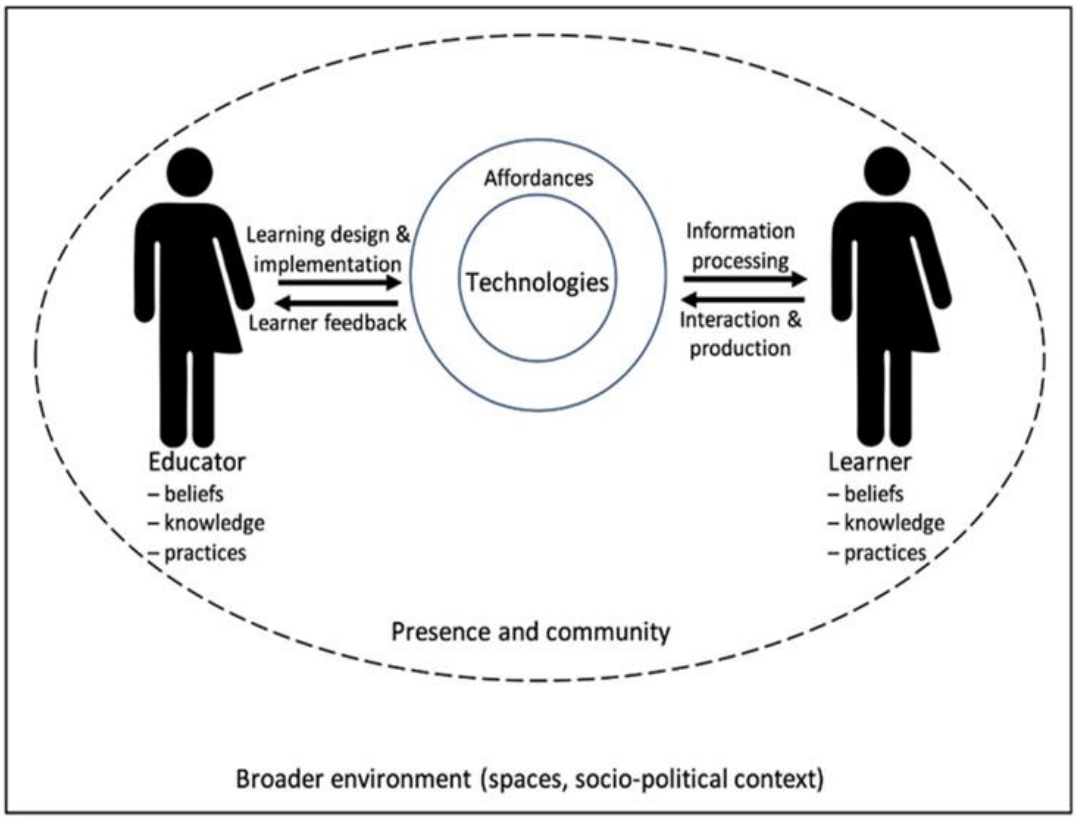

Fig. 3. Technology-mediated learning theory

So, without the mediation of the digital technologies, the communication and any associated learning would not occur. Digital technologies are electronic tools, system, devices and resources that generate, store or process data. The Emergency Remote Teaching was conducted through digital devices such as computer, laptops, mobile phones. Technology links people during the remote lesson. Presence refers to the state or fact of existing or being present whereas a community refers to a group of people living in the same place or having a

particular characteristic in common. In this situation, community refers to the Literature lecturers and students and they meet in a digital environment. In order to have a strong sense of present and community, the Literature lecturers and students need to have a proper teaching-learning process. When the teaching-learning process is strong during the remote teaching, it strengthens the bond between the lecturers and students. By this, it enhances the communication skills between both parties. Sociopolitical is something that involves both social and political factors. The government had announced that all schools must be closed due to this pandemic. This is the reason of the Emergency Remote Teaching to take place in the education system. It is important for the lecturers and students to apply these three concepts which are belief, knowledge, and practices in overcoming this crisis. They should have the belief that they would be able to overcome this crisis by conducting this Emergency Remote Teaching. Lecturers have the knowledge of the Literature syllabus and technology. So, they need to have multiple of practices to get familiarized with the Emergency Remote Teaching using technology. New technologies may also help to increase student motivation (Osborne & Collins, 2000), facilitate clearer thinking, and develop interpretation skills with data (Newton & Rogers, 2003). Similarly, students have knowledge regarding technology. They as well need to practice using Emergency Remote Teaching with the help of technology to increase their motivation, have a clearer thinking and also develop interpretation skills with data.

Conclusion. Covid-19 has led to a tremendous change in the Literature classrooms for the higher education institutions. This research aims to identify the importance of technology, how much the Literature syllabus had changed in the Literature classroom, and how did the Literature lecturers and students managed to overcome this crisis by conducting the Emergency Remote Teaching. These results

will answer the two research questions by showing how the Literature syllabus has been modified by the lecturers to ensure that the students can easily adapt to the lessons and assessments throughout the Emergency Remote Teaching. Also, the results in this study will show the importance of technology and how much had technology helped the Literature lecturers and students in ensuring the teaching-learning process takes place through the Emergency Remote Teaching.

This study's findings will underscore a gap between the Emergency Remote Teaching and technology. This is said because, Emergency Remote Teaching became the new way of teaching due to the Covid-19 pandemic. For decades, scholars have pointed out that educators have been "ill-prepared to teach with technology" (Foulger et al., 2017, p. 418) and this study will show that the lack of preparation, training, and support the participants had for designing quality instruction with technology will create additional stressors and barriers to teaching and learning remotely in times of need. Educators felt that face-to-face interaction is still the core of teaching and learning environment where it provides a rich context of instruction than learning in an online environment (Arinto, 2007; Hill, Chidambaram, & Summers, 2013). This is the first experience of the lecturers and students to have a different mode of teaching due to the crisis. When the Literature lecturers and students experienced Emergency Remote Teaching, they realized that they had to use the educational platforms to conduct the teaching-earning process. Due to this, they might encounter network issues, which might make them to not have an interesting lesson with the students when using technology. Other than that, they would have got used in using the website partially during the face-to-face teaching, but they might be using the website fully throughout the Emergency Remote Teaching. Due to this, errors for the higher institution's websites like system corruption might occur which lead the lecturers' and students' work to be

on pending. Also, this extends the time to get their work done. The gaps between the Emergency Remote Teaching and technology exist due to the lack of experiences which the lecturers and students have towards Emergency Remote Teaching and technology.

Moreover, there is a gap between the Emergency Remote Teaching and the Literature syllabus. When the lecturers conduct their teaching remotely, they would be aware of the mode of teaching to ensure that students understand the content delivered by them. Lectures, assessment and examinations are the content that consist in a Literature curriculum. Since it is a remote teaching, the lecturers will make some modifications for the Literature syllabus to make sure students adapt to the topics. Also, the lecturers have to prepare an assessment according to the mode of teaching. Biggs (1998) argues that the effectiveness of formative assessment is dependent upon the student's accurate perception of the gap, as well as their motivation to address it. Due to this remote teaching, students would have some difficulties in completing the assessment since there will not be any live demonstration during presentation. During the face-to-face teaching, group work is highly encouraged in Literature classrooms and students were able to demonstrate their presentation creatively during their formative assessment. Now, it is difficult for them to have discussion with their group mates since they are unable to meet each other. Also, the remote presentation will not be as effective as the face-to-face teaching. Since poetry, novels, drama, and short stories are the main elements in a Literature syllabus, students will also feel bored as they are learning Literature without any demonstration. Videos showed by the lecturers might be lagging due to the poor connection. This will also lead to a poor attendance in a Literature classroom during the Emergency Remote Teaching.

As a suggestion, blended teaching is highly recommended in Literature classrooms as the lecturers and students would be able to balance the classical way of teaching and remote teaching. Also, both would be able to learn more features on technology to enhance the teaching-learning process. Kahoot, Padlet, Scribbl, and PowerPoint slides are some examples of features that could be implemented in Literature classrooms using technology. The common motivation to introduce these technologies is that they may empower the individual knowledge worker by providing the tools to support and boost his or her knowledge-sharing skills (Tampoe, 1996). As a lecturer, it is important for them to enhance the usage of technology among the students in the classroom to ensure that it motivates students in having a wide knowledge. Lecturers could give students task using the educational applications to improve students' creative skills. In a way, it will become a student-centered learning and lecturers could easily deliver the content of a topic.

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