215

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Introduction

What does it mean „Responsible Educational Research (RER)" ?

The main objective of this volume of our Journal is to build a strong background of partnership and community of various European institutions in the area of Responsible Educational Research (RER) in order to share knowledge, best practices, experience and foster the dissemination and promotion of philosophy of RER.

Specific goals of this volume are as follows:

- to enable European researchers to undertake the educational issues connected with the health, gender, sustainable development, ICT in education and inclusive education in responsible way,
- to exchange knowledge between universities and enable them to transfer experience from their projects and research,
- to ensure the possibility for the researchers and other stakeholders to represent their work to the community and other scientists in Europe and beyond,
- to develop the governance for the advancement of responsible research by all stakeholders (researchers, policy makers, business and civil society organisations), which is sensitive to society needs and demands and promotes responsible educational research,
- to foster sustainable interaction between research institutions, business and policy makers,
- to ensure the dissemination of information about scientific achievements in the area of educational research at the international level.

The following factors are crucial for the development of educational research: open access, ethics and transparency. So far, none comprehensive activities have been taken that would clearly define the issues of transparency and responsibility of educational research.

The first important factor is **an open access** to scientific publications and articles. Currently, it is believed that access to research results contributes to the overall improvement of the quality of research and innovation in both public and private sectors. In principle, such activities are to support creation of the European Research Area and the Innovation Union – the two flagship initiatives of the European Commission in the field of research and development.

Open access is defined as the practice of providing on-line access to scientific information that is free of charge to the end-user and that is re-usable. In the context of research and innovation, scientific information can refer to peer-reviewed scientific research articles or research data. Wider access to scientific publications and data therefore helps to build on previous research results (improved quality of results), foster collaboration and avoid duplication of effort (greater efficiency),

accelerate innovation and involve citizens and society (improved transparency of the scientific process).

The next important factors are **transparency and ethics.** Researchers have an ethical obligation to facilitate the evaluation of their evidence-based knowledge claims through data access, production transparency, and analytic transparency so that their work can be tested or replicated. For example, researchers making evidence-based knowledge claims should provide a full account of how they draw their analytic conclusions from the data, i.e. clearly explicate the connecting data to conclusions. In case of educational research this issue is particularly important.

Transparency is one of the crucial criteria in educational research. Researchers are sensitized by transparency in the scope of advantage and disadvantage aspects of research project. It protects readers, as well as authors, from illegal inferences and distant associations which are beyond the reach of research project. Transparency provides conditions for verification of presented research results. Science education, focusing on human and social processes associated with its development and functioning, enters an area empiricism so many times, each time trying to determine the condition of the part of individuals and the conditions in which they have to operate. From the point of view of a certain scientific community, credibility of observations made and statements formulated based on them depend on the accuracy of methodological solutions adopted in this community. So it is particularly important in the process of publishing research results to gain transparency of their course, giving recipients the opportunity to review conclusions, without which they are exposed to the dangers of subjectivism, unauthorized generalization and interpretation of data collected during the research process. Transparency in presenting the results of the observations is particularly important for young scientists [Sławomir Pasikowski, *Transparentność w publikowaniu wyników badań empirycznych poświęconych edukacji (Transparency in publishing results of empirical research on education)*, Educational Studies Review, Vol. 1, No. 16 (2013)].

In a European context the following points of reference should be reflected in the design of research processes:

- ethical acceptability, which includes compliance with both the EU charter on fundamental rights, as well as the safety of research,
- orientation towards societal needs, which includes an orientation towards contributing to achieving objectives of sustainable development (consisting of economic, social, as well as environmental aspects).

Due to the fact that the volume is focused on responsible educational research, it is necessary to analyse the definition and main aspects of responsible research.

Firstly, responsible research refers to the comprehensive approach of proceeding in research, in ways that allow all stakeholders that are involved in the processes of research and innovation at an early stage. It enables:

- to obtain relevant knowledge on the consequences of the outcomes of their actions and on the range of options open to them,
- to effectively evaluate both outcomes and options in terms of societal needs and moral values,
- to use these considerations as functional requirements for design and development of new research.

Responsible research aims mainly at being:

- responsive: if research claims to be responsible, it has the capacity to change its direction or shape when it becomes apparent that the current developments do not match societal needs or are ethically contested; responsiveness refers to the flexibility and capacity to change research and innovation processes according to public values,
- inclusive: inclusiveness asks researchers and innovators to involve diverse stakeholders in the process to broaden and diversify the sources of expertise and perspectives,
- reflexive: reflexivity asks researchers and innovators to think about their own ethical, political or social assumptions to enable them to consider their own roles and responsibilities in research, as well as in public dialogue; reflexivity should raise awareness for the importance of framing issues, problems and the suggested solutions (Options for strengthening Responsible Research and Innovation, European Commission, 2013).

The articles had undertaken the challenge of being the examples of a good practice in the area of RER, and open-acces to them is one of the factors of transparency in our professional development.

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FOLIA 215

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SCIENCE, CULTURE, SOCIETY – NEW CONTENTS AND EDUCATIONAL CONTEXTS

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What next for diabetes mellitus?

Introduction

Diabetes mellitus is a chronic heterogeneous disease, known for millennia, which essentially afflicts its sufferers until the end of their lives. Although it has already been addressed in numerous scientific publications, its etiopathogenesis is still far from conclusive explanations, and its nature still remains a mystery. Diabetes is currently defined as a group of metabolic diseases characterized by hyperglycemia, that is increased levels of sugar in blood, resulting from impaired synthesis or secretion of insulin released by the β cells of the pancreatic islets of Langerhans. Chronic hyperglycemia leads to the damage, functional disorders and insufficiency of many organs, particularly the eyes, the kidneys, and the cardiovascular system. With regard to its etiology and course, diabetes is divided into type 1, type 2 and gestational type.

The general principle of the contemporary therapy for diabetes involves treating all the coexisting disorders instead of merely restoring the carbohydrate metabolism. The risk of complications of the disease is decreased by such means as normalization of body weight, increased physical activity, balanced diet, treating lipid metabolism disorders accompanying diabetes, as well as arterial hypertension and other cardiovascular diseases, and maintaining the glycemic index at levels possibly closest to its physiological norm.

Symptoms of diabetes mellitus

Characteristic changes occurring in states of uncontrolled diabetes in humans include, among other things, an increase in glucose concentration in blood, intensification of glycogen degradation, and an increase in the rate of gluconeogenesis, the oxidation of fatty acids and the formation of ketone bodies and urea (Drzewoski, 2001). Another indication is a decreased rate of the biosynthesis of glycogen, lipids and proteins in the cells of insulin-dependent tissues, such as muscles and the fatty tissue. These cells use a distinctive, insulin-dependent system of glucose transport

to the protoplasm, whose impairment in diabetes is caused by the high concentration of sugar in blood. Such a transport system is inefficient in the event of insulin deficiency. In the case of insulin-independent cells, the entry of glucose into the cell is largely controlled not by insulin, but by the concentration gradient between its exogenous and endogenous environments. Within such cells, an excessive utilization of glucose might take place. What therefore occurs is the "reversing" of glucose from insulin-dependent metabolic pathways to those which do not require the presence of the said hormone. An excessive utilization of glucose, resulting from an increase in its intracellular concentration and affecting the course of many processes within insulin-independent tissues, might contribute to many pathological changes in the course of chronic diabetes (Busetto et al., 2016).

In the course of diabetes mellitus, there are numerous factors leading to the increased production of free radicals, while at the same time impairing the potential for their elimination. Oxidative stress contributes primarily to the modification of protein and DNA structure, which is negative for the organism (Liu et al., 2016), as well as to deficiencies in NADPH oxidase which is crucial for both the production and action of such antioxidants as glutathione or vitamin C (Niki, 1991). Free radicals in diabetes are also formed as a result of the non-enzymatic glycosylation of proteins, which in turn is a consequence of chronic hyperglycemia. Non-enzymatic glycation of proteins is a process occurring spontaneously in living organisms and the accumulation of its products in tissues intensifies with age (Yamagishi, Matsui, 2016), which might indicate that non-enzymatic glycosylation contributes to the process of aging of the organism. At the same time, such diseases as diabetes mellitus or renal insufficiency lead to the intensification of non-enzymatic glycosylation.

An increase in the non-enzymatic glycation of proteins can be observed in uncontrolled or improperly controlled diabetes. In the human organism, the γ-amino groups of lysine and the free amino groups of valine in protein chains undergo a three-stage glycation reaction. A glucose molecule is bonded to a protein, which might cause significant changes in its properties. The glycation process depends on the concentration of glucose and the duration of the process. In chronic diabetes, the glycosylated form of e.g. hemoglobin (HbA1c) has a different affinity for oxygen, which may contribute to hypoxia. Additionally, in chronic diabetes, glucosamine-protein complexes are formed which cause biochemical and morphological changes in capillaries. Also, the glycosylation of collagen increases, which affects the thickening of the glomerular basement membrane of the kidney (Frei et al., 1988). The intensified transformation of glucose into fructose on the polyol pathway in diabetes results from an increased intracellular concentration of glucose in tissues using an insulin-independent transport system (the lens, the liver, the kidneys, peripheral nerves) and from a high NADPH/NADP+ ratio caused by a decreased rate of other reduction reactions, e.g. fatty acid synthesis. It is worth mentioning that the accumulation of sorbitol leads to osmotic disorders, which play a significant role in the etiology of cataract (Mehta et al., 2006).

Chronic diabetes might lead to numerous complications. Some of them are affected by the buildup of cholesterol in arteries, atherosclerosis of coronary vessels or large blood vessels of the lower limbs. Impairments of the nervous system, including the autonomic nervous system, may also occur. Moreover, the eyes and the kidneys might be subjected to characteristic alterations due to changes in the lens and in the basement membrane of small blood vessels. In this context, diabetes mellitus is also interpreted as the most common cause of end-stage renal disease, which results from damage to glomerular capillaries constituting a part of the general microangiopathy (Morita et al., 1991). The risk of development of those complications is much higher when diabetes is improperly monitored. It is not a rule, though, as they might also develop chronically in patients receiving adequate treatment (Chan et al., 2016).

Insulin and glucagon

Insulin and glucagon control the metabolism of peripheral tissues and take part in maintaining their homeostasis (Ochwanowska et al., 2009; Witek et al., 2001). Insulin is an anabolic hormone which induces the biosynthesis of proteins, fats and glycogen, and at the same time inhibits the degradation of those compounds. The liver, muscles and fatty tissue are areas which are particularly rich in insulin receptors (Cariou, 2015). Glucagon affects the increase in catabolic processes, mainly in the liver (Authier et al., 1992). A normal concentration of glucose in plasma secures the main source of energy for tissues and its utilization requires a constant presence of insulin. Thanks to the antagonistic effects of glucagon and insulin, the organism is protected from the development of hypoglycemia during hunger or intensive physical exercise, that is in cases when a mobilization of greater sources of glucose is necessary (Nathan, 2015). It is understandable that insulin deficiency impairs the utilization of glucose and the excess of glucagon increases its concentration in blood (Gallichan, 1997). A high concentration of glucagon as compared to insulin in diabetic patients considerably accelerates the breakdown of glycogen and stimulates the excessive rate of the release of liver glucose into the blood. As a result of diabetes, a significant qualitative change of energy substrates may occur, particularly from carbohydrates to fats, which – due to the formation of ketone bodies – might lead to acidosis, coma, or even death, if diabetic patients do not receive adequate treatment. The consequence of diabetes is a long-term emaciation of the organism.

Regulation of the secretion of insulin and glucagon

Factors regulating the secretion of insulin and glucagon and inducing changes in their concentration in the circulating blood include the normal concentration of glucose and amino acids in plasma, the presence of many types of hormones, as well as sympathetic and parasympathetic stimulation. In the presence of insulin, amino acids can increase the rate of entry into cells and prevent the occurrence

of hypoglycemia through adequate stimulation of glucagon secretion (Battezzati et al., 2003).

The concentration of glucose in blood depends on the speed of its absorption in the intestines, the rate of its storage in the liver and the degree of its utilization by peripheral tissues. The most important parameter for the diagnosis of diabetes is thus the concentration of glucose in blood primarily in fasted patients. Normal concentration of glucose in fasting blood oscillates in the range of 70–105 mg/dL (3.89–5.83 mmol/L); after a meal it might increase to 126 mg/dL (7.0 mmol/L). Glucose concentration of over 180 mg/dL (10.0 mmol/L) induces glucosuria. According to guidelines developed by the National Institutes of Health (NIH), an agency of the United States government dealing with biomedical and public health research, in order to diagnose diabetes, the concentration of sugar in fasting blood should be higher than 140 mg% (100 mg% = 5.6 mmol/L sugar in blood), that is 7.84 mmol/L. This or higher value should be verified at least twice (Sharabi, 2015). If the results do not allow for a definite interpretation, the oral glucose tolerance test (OGTT) should be performed. A patient receives 75 g of glucose and the determination of glucose concentration in blood is carried out at 30-minute intervals for 2 hours after its administration. In healthy individuals, the concentration 2 hours after the oral load of glucose is either the same, similar or lower than the initial concentration. Diabetes is diagnosed when the concentration of glucose in venous blood plasma 2 hours after the load of this sugar is higher than 10.0 mmol/L.

Glucose tolerance lowers with age, which is why it is recommended that an adjustment should be made to the values of glucose in whole blood or plasma by adding 0.056 mmol/L per each year over 60 years of life. Negative effects of diabetes, irrespective of its pathogenesis and type, are primarily the consequence of hyperglycemia and pertain mainly to the vascular system. The effects of those changes are retinopathy, nephropathy, or diabetic neuropathy (Gerich, 2000). The etiology of vascular complications of diabetes has yet to be fully determined, even though the correlation between hyperglycemia and vascular disorders is evident. It has been demonstrated that an adequate management of glycemia allows for a more detailed analysis of the development of complications with respect to vascular diseases (Van Leiden et al., 2003).

Research on diabetes – historical outline

It is known that man has been plagued by diabetes for centuries, for the Ebers Papyrus from as early as 1550 BC mentions a disease whose course was accompanied by polyuria. Hippocrates observed that fly swarms tended to fly towards the urine of those individuals whose secretion was sweet and whose disease, through the state of coma, caused immediate death. In the 2nd century AD, Aretaeus of Cappadocia characterized the condition as “the dissolution of body and extremities in urine”. The description referred to the excretion of large amounts of urine (polyuria) and decreased body weight in patients – symptoms characteristic for

uncontrolled diabetes. Because of the "unquenchable thirst" accompanying the condition, Aretaeus termed it diabetes (Greek *diabetes* – siphon). The second element of the name, i.e. mellitus, was not added until the 18th century, upon determining that the urine of diabetic patients had a sweet taste (Latin *mellitus* – sweet) (Ionescu-Tirgoviste, 1996; Majumdar, 2001). The main contemporary stream of research began in 1886, when Josef von Mering, a German scholar, discovered the so-called phlorizin diabetes in dogs.

Diabetes is the most common endocrine disorder connected with endocrine pancreatic insufficiency. In 1921, Frederick Grant Banting, a Canadian medical scientist, and Charles Herbert Best, an American-Canadian biochemist, extracted insulin from canine pancreatic islets and found that the extract decreased the concentration of glucose in blood (Cheymol, 1971; Witek, Kołątaj, 2012). The discovery would not, however, be possible if it was not for the earlier research studies conducted by Oskar Minkowski, a German doctor. Minkowski proved that there existed a connection between diabetes mellitus and the pancreas, and that it was precisely that organ where the cause of the disease should be sought. In order to demonstrate that the human organism was unable to function without the pancreas, he carried out scientific experiments on dogs with the help of Joseph von Mering, the co-discoverer of diabetes. In 1889, they found that complete pancreatectomy (complete removal of the pancreas) in dogs resulted in symptoms similar to diabetes mellitus in humans (von Mering, Minkowski, 1890). Since then, research has developed on the pancreas as a source of medicinal substance which could be used for treating diabetes. In partial atrophy of the organ, after excretory duct ligation, the undamaged Langerhans islets were still able to protect the organism from the disease.

The discovery of pancreas-derived diabetes by Minkowski and von Mering triggered a worldwide search for an antidiabetic agent within the pancreatic gland (von Mering, Minkowski, 1890). At the beginning of the 20th century, patients suffering from diabetes were diagnosed with the presence of pathological cells in the pancreatic islets (Dominguez, Licata, 2001; Hara et al., 2016). For that discovery, and for "obtaining insulin in the form of an active extract from animal pancreas and its application in the treatment of diabetes", the Nobel Prize in Physiology or Medicine was awarded jointly to Frederick Banting and John James Rickard Macleod, a Scottish physiologist, in 1923 (Bliss, 1989; Shampoo, Kyle, 2005). Since then, the application of insulin revolutionized the treatment of diabetes and became the ground for the worldwide research into the structure and function of insulin. A major advancement was reached in 1955, when Frederick Sanger, a British biochemist, published his report on the primary structure of insulin, constituting the first representation of the sequence of amino acids in a peptide hormone molecule (Maruyama, 2002). In 1969, Dorothy Mary Hodgkin, a British biochemist, determined the spatial structure of insulin based on crystallographic studies (Howard, 2003).

Types of diabetes

Diabetes belongs to a group of conditions described as civilization diseases and its prevalence in the human population has reached alarming levels in the past few years (Aziz et al., 2015). The World Health Organization has deemed diabetes to be the epidemic of the 20th (now also 21st) century. It is estimated that the problem is now being faced by a population of approximately 200 million people, and the number is predicted to reach over 300 million by 2025 (WHO, 1994).

Today, it is known that two main types of diabetes – type 1 and type 2 – impair the metabolism of not only carbohydrates, but also proteins and fats, and that the disorders very often appear long before the actual manifestation of the disease (Polsky, Ellis, 2015).

Diabetes mellitus type 1

Diabetes type 1 occurs mostly in children and adolescents. It is diagnosed in about 0.25% of individuals under 20 years of age, which is why the type has been termed as juvenile diabetes or IDDM (insulin-dependent diabetes mellitus). This type of diabetes is completely insulin-dependent, which means that pancreatic β cells in diabetic patients release very little or no insulin at all. Diabetes type 1 of autoimmune character, also called LADA (latent autoimmune diabetes in adults), can have a slow onset and occur in adults. It is characteristic of 50% of patients of slim build and older age – an age group typical of diabetes type 2 (Pozzilli, Di Mario, 2001). The underlying cause of diabetes type 1 is the autoimmune destruction of β cells within the Langerhans islets. Predisposition to this type of diabetes is genetic and may occur at any age of life. Environmental factors, such as diet, stress or viral infections, also play a significant role in the development of diabetes type 1.

Autoimmune processes are believed to be the cause of diabetes type 1 (Collessa et al., 2002; Körner et al., 2002). A significant role in its pathogenesis is also played by viral factors, which can be inferred from the increased prevalence of type 1 diabetes after rosacea or Coxsackie virus infections (Trukhan, 2001), less often after mumps or cytomegaly. This type of diabetes can also be transmitted as a result of bone marrow transplantation or experimental tests. The autoimmune process involves the destruction of overloaded β cells of Langerhans islets. A destruction of 75% of their number results in the impairment of glucose tolerance and induces the first symptoms of the disease (Peczyńska et al., 2002).

Despite research studies that have been carried out, inter alia, on twins, no sufficient explanation has been found of whether genetic predispositions have any influence on the occurrence of type 1 diabetes, even thou there exists data validating such possibility. Clinicists have been searching for similarities in the structure and function of specific types of antibodies in parents, their children and siblings suffering from diabetes type 1 (Bieniasz, Wąsikowa, 2002). In 10% of children with diabetes type 1, the disease was diagnosed in one of the parents, and only 5% of those children had usually one grandparent with this type of diabetes. If both

parents are diabetic, the risk of inheriting the disease by each of their children is 10%, while if one of the siblings has diabetes type 1, the risk for it in another one is 3–7%. In twins, the risk for developing the disease in the other sibling is 20–30%, while in monozygotic twins the risk is 30–50%.

Studies by Kubryn et al. (2002) found that main genes connected with the predisposition to diabetes mellitus type 1 in the Polish population are the HLA-DRB1 and DQB1 genes. Krischer et al. (2003) have continued research into the strategy of searching for immune markers in the relatives of patients with diabetes type 1.

Research on diabetes mellitus type 1

The issue of diabetes prevention constitutes a challenge for diabetologists and research into the matter is being carried out constantly. As regards the pathogenesis of diabetes type 1, particular emphasis is being placed on the role of oxidative stress, and the possibility is being explored of the application of "sweepers" of oxygen free radicals, e.g. nicotinamide or vitamins C and E (Crino et al., 2002). However, the European Nicotinamide Diabetes Intervention Trial (ENDIT), a large multinational study on the role of nicotinic acid concluded in 2002, did not verify that it had any significant protective value.

High hopes were also placed on the preventive administration of small doses of insulin to children presumed to be at high risk for diabetes type 1. However, studies on the parenteral administration of insulin did not yield any clear proof that the procedure indeed prevented the development of the disease (Pozzilla, 2002). What is more, no conclusive reports have been presented concerning the application of anti-inflammatory preparations or vitamin D3 analogs in the regulation of the concentration of ionized calcium which has a significant impact on insulin secretion. However, research papers have been published reporting the existence of a strong effect of vitamin D3 on the inhibition of diabetes type 1 through modulating the activity of T cells and reducing the speed of the insulinitis process (Zella, DeLuca, 2003).

It is indicated that a positive effect on the normal functioning of pancreatic β cells might be produced by natural breastfeeding and a several-month period of gluten-free diet, which is believed to prevent the immunotoxic effect of cow's milk protein (Pastore et al., 2003). Additionally, attempts are being made at the immunosuppression and immunomodulation of autoimmunization processes and the acceleration of β cell apoptosis by means of gene therapy in both the treatment and prevention of this type of diabetes (Efrat, 2002; Falqui et al., 2001).

Diabetes mellitus type 2

Diabetes type 2 is referred to as adult-onset diabetes or NIDDM (non-insulin--dependent diabetes mellitus). It is connected with genetic predispositions of a given human ethnic group and with dietary habits, and is mostly precipitated by poor physical activity, obesity and advanced age. Individuals with diabetes type 2

requiring insulin treatment are not in fact insulin-dependent, as their organisms are still capable of the residual secretion of the hormone.

Diabetes mellitus type 2 is the most common type of diabetes and is characterized by a dichotomy of sorts. The condition is genetically-based but is also considerably affected by environmental factors inducing this genetic predisposition. The genetic and the environmental factors have an equal share in increasing or inhibiting the rate of insulin secretion.

It seems that researchers should pay special attention to the crucial role of genes responsible for the structure of glucose transport proteins and the regulators of their activity, including protein kinase C, phospholipase and the phosphatidylinositol system, though the multigenic pathogenesis of diabetes type 2 requires a further in-depth analysis. A significant role in the regulation of insulin secretion can also be played by changes within mitochondrial DNA or the genes of certain regulatory proteins (Fajans et al., 2001). An impairment of insulin secretion may be caused by different types of polymorphism within the genes of glucose transport proteins, specific glycolytic pathway enzymes, potassium channel proteins and the related sulphonylurea receptors, as well as calcium channel proteins and the so-called calcium cascade proteins (Malaisse, 2001). Different types of polymorphism can lead to reducing the rate of insulin secretion and increasing the amount of damage to pancreatic β cells, especially in the case of obesity-related insulin resistance.

Environmental factors are essentially elements of the contemporary lifestyle of developed civilizations, particularly high-calorie foods combined with very little physical activity, constituting the main cause of obesity and the associated insulin resistance (Putti et al., 2016). Metabolic disorders related to obesity, such as hypertriglyceridemia, low HDL levels (American Diabetes Association, 2003), hyperinsulinemia or impaired glucose tolerance, are the first symptoms of a developing polymetabolic syndrome (Taylor et al., 2015).

Research on diabetes mellitus type 2

Diabetes type 2 is a progressive condition characterized by the initial development of insulin resistance along with an insulin secretion defect, and then the prevalent impairment of β cell functions with persistent insulin resistance (WHO, 1999). The European Diabetes Policy Group (EDPG) provided guidelines clearly indicating the need to adjust the treatment regimen to the stage of diabetes mellitus. According to EDPG recommendations (EDPG, 1999), treatment should begin with the modification of lifestyle and dietary patterns. However, the United Kingdom Prospective Diabetes Study (UKPDS) demonstrated that this method does not help to achieve, for instance, a significant reduction of the level of glycated hemoglobin, that is glycemia (UKPDS, 1998). EDPG recommends to begin with monotherapy, and in the next step switch to combination therapy with two, or even three hypoglycemic drugs with different action mechanisms. Nevertheless, further preventive treatment should allow for the need to introduce insulin therapy. It has been found that in the

period of 5 years of the duration of diabetes type 2, the inefficiency of sulphonylurea derivatives occurs in about 1/3 cases. The first stage of insulin treatment of this type of diabetes should consist of the so-called combination therapy, i.e. using both oral medications and insulin (Yki-Jarvinen, 2001), while the next stage should involve a complete substitution by insulin, through various models of use of pre-mixed insulin, or monotherapy, e.g. a basal-bolus regimen – a form of intensive insulin therapy.

The treatment regimen for diabetes type 2 should be monitored and changed as soon as the effectiveness of the originally adopted solutions becomes limited. Such an approach allows to fulfil criteria for regulating this type of diabetes, which are not limited to carbohydrate balance, but cover the normalization of lipid disorders and the regulation of arterial hypertension as well (Lamos et al., 2016).

Other types of diabetes mellitus have also been differentiated. Gestational diabetes develops in 3% of pregnant women, while MODY diabetes, that is maturity onset diabetes of the young, occurs in less than 2% of the population of type 2 diabetic patients. There exists convincing evidence that the pathogenesis of diabetes type 2 and its commonly coexisting disorders are a consequence of the interaction between genetic and environmental factors (Hitsumoto, 2016).

What next for diabetes? Future prospects

Since the central problem in diabetes mellitus is the impaired functioning of the pancreas, it seems that the easiest solution would be to replace the impaired organ. Pancreas transplantation has been known since 1966, when the first such surgery was performed in the USA. In Poland, pancreas transplants have been carried out since 1988. The surgery has been performed on patients with diabetes type 1. Apart from living organ transplantation, research studies have also been carried out into a synthetic substitute for pancreas. The first such prototypes were created in the 70s of the 20th century, but they were rather large. Modern models are much smaller, but they are still unfit for everyday use. Nonetheless, researchers entertain the hope that the endeavor will prove successful. A method less invasive than the transplantation of the whole pancreas is transplanting the Langerhans islets. This procedure, however, is still in the phase of experimentation. The problem is that the cells are transplanted from a deceased donor, which is why their number from a single donor is too low, and their functional properties decline during the transplantation procedure. Another disadvantage is the fact, that each transplant entails the need for a lifelong immunosuppressive therapy, which reduces the efficacy of the immune system and weakens the organism.

An interesting solution for the transplantation-based treatment of diabetes is stem cell transplant. Stem cells, which are obtained from cord blood and peripheral blood, can develop into pancreatic β cells responsible for the synthesis of insulin. Such transplantations have been successfully performed in Poland and in Brazil. So far, the method has been used in the treatment of diabetes type 1.

People suffering from diabetes mellitus very often have difficulties maintaining a healthy weight. Therefore, a good method in the treatment of diabetes seems to be any measure adopted against obesity. One of those methods is treatment with the use of the Tantalus II generator. Three pairs of electrodes are laparoscopically implanted into the patient's stomach walls. The electrodes are connected to an electrical impulse generator located under the skin, similarly to a pacemaker. Unlike a pacemaker, however, the Tantalus II generator is not continuously active in an obese patient, but creates an impulse when detecting that food is being delivered into the stomach. The impulse increases the number and intensity of gastrospasms, which in turn increases the speed of gastric emptying. This is of particular importance, as diabetic patients suffer from delayed gastric emptying. But this is not where the task of the generator ends. The electrical impulse reaches the satiety center of the brain through the vagus nerve, triggering a signal informing the organism about reaching satiety. It seems that treatment using the Tantalus II system might change the lives of those type 2 diabetes patients in which neither diet, nor physical exercise bring any desired outcomes in terms of blood sugar regulation. Observations of patients treated with the use of the Tantalus II generator suggest, that the system provides an efficient and very promising treatment method, which prevents damage to the cardiovascular system, the kidney or the eyes, and – most importantly – relieves sufferers from the need to take insulin (Sanmiguel et al., 2009). Still, there are certain medical contraindications to this treatment method, including, among other things, diabetes type 1, insulin therapy, diabetes lasting more than 10 years, and the age of over 65 years.

Perhaps the next step in the fight against diabetes mellitus type 2 might be the use of gliflozin drugs – sodium-dependent glucose cotransporter 2 inhibitors. They are a class of orally administered medications used in the treatment of diabetes type 2. Gliflozin drugs are expressed in the kidneys, inducing an increased excretion of glucose in urine. This contributes to reducing the level of glucose in blood, burning extra calories, and consequently reducing body weight (Doggrell, Tuli, 2014). The medication is relatively new; therefore, its adverse effects have not been fully explored yet.

Perhaps a new direction of search for diabetes medications might be an attempt to increase the storage of glucose in the liver. Throughout the last decade, the most significant advancement in the treatment of diabetes type 2 was connected with the development of incretin-based drugs which control glucose homeostasis by affecting the intestinal-pancreatic axis and its central figure, namely the glucagon--like peptide-1 (GLP-1). GLP-1 analogs are parenterally administered drugs acting directly on pancreatic β cells, stimulating them to secrete insulin only as glycemia increases. They do not act under conditions of normoglycemia, and as such do not trigger hypoglycemia (Jafri et al., 2016).

Researchers of different specialties indicate novel and promising directions in the fight against not only diabetes mellitus, but also autoimmune diseases, such as rheumatoid arthritis, multiple sclerosis or celiac disease. Many of the medications

tested so far have not yielded the desired improvement in the treatment of the above and other conditions. Today, diabetes mellitus is sadly still not a curable disease, although by virtue of the progressive achievements of researchers within many interdisciplinary fields, the disease is becoming less and less burdensome, and the risk of complications, which are undoubtedly an additional source of worry, continues to decrease.

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What next for diabetes mellitus?

Abstract

Diabetes mellitus is a metabolic disease, characterized by an increased concentration of glucose in blood, accompanied by disordered metabolism of carbohydrates, fats and proteins resulting from insufficient secretion or action of insulin. Diabetes is a chronic disease which generally afflicts its sufferers until the end of their lives. The continuous progress in the treatment and, above all, prevention of diabetes has become a significant factor which might contribute to reducing the incidence of different groups of concurrent complications. The manifold aspects of the significance of diabetes as a problem, which is not solely of a metabolic nature, inclines researchers to adopt an interdisciplinary approach to the disease. The multifactorial and comprehensive prevention and treatment of diabetes through, among other things, adequate pharmacological intervention, might significantly reduce the risk for its numerous multi-organ complications, but also the risk of patient's death.

Key words: diabetes, insulin, glucagon

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Role of diet in primary prevention of colorectal cancer

Colorectal cancer and primary prophylaxis

In the group of cancerous diseases colorectal cancer was classified by the World Health Organization (WHO) on the third position from the aspect of the number of cases and deaths (Kubiak et al., 2014). In 2012, 1,360,602 people worldwide fell ill with colorectal cancer, and approximately 693,933 died due to this cause (Król, Kapka-Skrzypczak, 2011). Such a high position in the ranking by the WHO is the result of poorly effective actions in the area of primary and secondary prevention (Schuz et al., 2015), despite the fact that this is one of the best recognized cancerous diseases, and knowledge concerning the stimuli triggering the processes of its development is comprehensive. This is a diet-related disease which means that the risk of occurrence of the disease is modified by means of dietary habits.

Early detection of colorectal cancer improves treatment prognoses. However, the majority of patients undergo the therapy too late, which results in a low effectiveness of the treatment methods applied (Kubiak et al., 2014; Król, Kapka-Skrzypczak, 2011). Late detection of the disease results from problems associated with an effective system of diagnosing. At an early stage, the symptoms are difficult to observe, additionally, low awareness of both physicians and patients indicates the necessity for placing a greater emphasis on actions biased towards primary and secondary prevention (Kubiak et al., 2014; Schuz et al., 2015; Cancer Prevention WHO, 2016). Dietary and health education modifying factors related with life style should prove effective.

An argument in favour of primary prophylaxis are also costs of cancer treatment, which in the European Union have been estimated at 126 billion EUR (data of 2009). Oncologic treatment considerably burdens the national budgets and also has its social aspect. Despite the fact that cancerous diseases afflict mainly older population, a large number of new cases is observed in the population group at productivity age, which entails difficult the estimation of indirect costs related with the occurrence of the disease, i.e. costs of productivity and work absenteeism, as well as costs of patient care (Luengo-Fernandez et al., 2013). It is presumed that implementation

of a health promoting life style, i.e. an adequate diet, increased physical effort or maintenance of a proper body weight, would result in a decrease in the number of new cases of colorectal cancer even by 47% according to the World Cancer Research Fund (WCRF) (Anderson et al., 2015). Thus, the improvement of the level of health knowledge in a time of unfavourable demographic changes related with the ageing of societies, poses a challenge to the present health and educational systems.

Diet and its components in colorectal cancer

From the aspect of an individual and possibilities to avoid a cancerous disease, so-called modifiable factors are of great importance, such as physical activity and diet. Food and the methods of its production, processing, preservation and storage may, on the one hand, trigger negative processes in the colorectal region; however, on the other hand, they may play a considerable role in cancer prophylaxis. Life span is increasing; and consequently, a longer life is related with an increased exposure to carcinogens; therefore, it is worthwhile using a diet as a modifiable carcinogenic factor in order to reduce the risk of development of the disease. An appropriately balanced diet and its individual components may favour, delay or even prevent negative phenomenon taking place in this section of the gastrointestinal tract.

The International Agency for Research on Cancer (IARC) in association with the European Union (UE) have issued recommendations concerning prophylaxis of cancerous diseases entitled the "European Code Against Cancer". Into the factors conducive for the development of colorectal cancer have been classified: obesity, consumption of red meat and its products, and alcohol (Schuz et al., 2015; Thomson, 2015).

Scientific studies confirm the relationship between BMI (Body Mass Index) and WHR (Waist to Hip Ratio), and the risk of contracting colorectal cancer (Pischon et al., 2006; Renehan et al., 2012; Tandon et al., 2015). In individuals with BMI higher than 25 kg/m^2 the risk of occurrence of colorectal cancer increases by 30–50% (Kiciak et al., 2012). Per each subsequent 1 kg/m^2 exceeded over the normal value of BMI this risk increases by 2% (Gray et al., 2012). It was found that morbidity increases in males in whom body weight gain took place in adult life (over the age of 18), and decreases with body weight loss (Renehan et al., 2012; Gray et al., 2012; Rapp et al., 2008). A similar relationship was not observed among females (Chan et al., 2011; Migdał et al., 2014). This may result from the fact that higher tendencies towards the development of the disease were noted in abdominal (visceral) obesity typical of males, than in gluteal-femoral (gynoid) obesity typical of females (Doyle et al., 2012; Lee et al., 2016).

The effect of obesity on carcinogenic processes in the colorectal region is explained in various ways. Metabolic changes accompanying an excessive increase in adipose tissue lead to an increase in the resistance to insulin, intensification of inflammatory states in the body, modification in the level of sex hormones, changes in the production of adipokines, cause oxidative stress and changes in immune

response. All these processes favour carcinogenesis (Schuz et al., 2015). In addition, nutritional behaviours leading to obesity, such as: an excessive consumption of processed products with low nutritional value, i.e. low content of fibre, micro- and macroelements, and a high contribution of simple carbohydrates and hydrogenated vegetable fats, affect the composition of the microflora of the colon and its peristalsis. In turn, the motility of the colon exerts an effect on the duration of the contact of gastric contents with the colon wall. The retention of undigested products triggers carcinogenic processes, while disorders in the bacterial flora of the colon weaken its structure and protective functions, leading to dysbiosis and intensified endotoxemia, and cause a chronic inflammatory state (Nowak, Libudzisz, 2008).

Also, the relationship between the occurrence of colorectal cancer and the consumption of products which have a high glycaemic index (GI) and glycaemic load (GL) is significant. Among Canadians surveyed from the aspect of daily diet during the period 1994–1997, those whose diet was characterized by high GI and GL more frequently contracted colorectal cancer (Hu et al., 2013).

Other observations made among the American population, the diet of which is based on high GI and GL, revealed a positive correlation between the above--mentioned indices and the prevalence of colorectal cancer (Gil et al., 2010), especially among individuals whose physical activity was on a low level. A high GI diet increased the risk of colorectal cancer by 69% in females and 87% in males (Ciok, Dolna, 2005).

The classification of food based on the above-mentioned indices specifies the effect of diet on the level of glucose in blood. Products with a high GI and GL cause the states of glycaemia, i.e. an elevated concentration of free glucose in blood, above the values adopted as normal. Glucose accompanies growth and proliferation of cancer cells (Dudziak, Regulska-Ilow, 2013). In addition, chronically persisting hyperglycaemia typical of type 2 diabetes is most often related with hyperinsulinaemia accompanying overweight and obesity, and enhances the processes of initiation and progression of cancer. Epidemiological studies showed that in patients with type 2 diabetes the risk of colorectal cancer increases even 1.5 times (Dudziak, Regulska-Ilow, 2013; Dąbrowski, 2010).

In response to the above-quoted reports, for the purpose of cancer prevention, the American Institute for Cancer Research (AICR) recommends the maintenance of normal body weight, irrespective of age, and a proper weight circumference, through physical activity and an adequate diet in order to avoid visceral obesity (Schuz et al., 2015). Elimination from the diet products containing easily absorbed carbohydrates, i.e. with a high GI and GL, should also, to a large extent, protect the intestine against carcinogenic processes (Gil et al., 2010; Dudziak, Regulska-Ilow, 2013).

The International Agency for Research on Cancer (IARC) considered red meat (pork, beef, and mutton) as a factor possibly causing colorectal cancer (Group 2A), whereas its products (cold cuts, sausages, pates etc.) as carcinogenic factors in the discussed section of the gastrointestinal tract (Group 1). This classification was based

on scientific reports which showed that the risk of contracting colorectal cancer increased by 14% per each 100 g of daily red meat and meat products consumed (Chan et al., 2011). The risk related with red meat concerns the colon rather than the rectum, whereas the consumption of its products affects the development of cancer concerning these both sections of the gastrointestinal tract (Chan et al., 2011; Fatima et al., 2009).

The carcinogenic effect of red meat has not been ultimately explained and requires further studies. One of the causes is the presence of heme iron which generates free radicals activating a number of unfavourable processes leading to changes in the colorectal region (Fatima et al., 2009; Samraja et al., 2015). In addition, during processing, especially an exposure of red meat to a high temperature, results in the formation of mutagenic substances, such as heterocyclic amines (HCA), or polycyclic amines, polycyclic aromatic hydrocarbons (PAHs) (Majcherczyk, Surówka, 2015; Klusek et al., 2011). Although the effect of consumption of red meat requires recognition of the mechanisms of effect on carcinogenic processes in the colon, there is no doubt concerning the carcinogenic effect of industrial meat products. The IARC placed these products in the group of factors with a high carcinogenic effect on humans (Group 1) (Can et al., 2011). Especially the substances used in meat processing, such as dyes, preservatives, acidity regulators, antioxidants, stabilisers and emulsifiers, flavour enhancers and others, are not indifferent to health (Majcherczyk, Surówka, 2015). Cold cuts are a rich source of PAHs produced during the processes of the smoking of meats. They may impair the genome and favour carcinogenic processes. The PAHs include several hundred compounds, 15 of which have a potentially carcinogenic effect. Nitrogen compounds added to cold cuts products for preservation purposes, during digestion are transformed into nitrosamines – strongly carcinogenic compounds (Migdał et al., 2014).

Concerning scientific publications, the WHO recommends the limitation of consumption of red meat to 500 g per week and avoidance of consumption of processed cured meat products (Schuz et al., 2015).

The risk of development of colorectal cancer is 1.4 times higher in individuals who regularly consume more than 50 g of ethyl alcohol per day, compared to abstainers. The relationship between colon and rectal cancer and the consumption of alcohol has been observed, irrespective of the type of alcohol consumed, because the carcinogenic factor in this case is ethanol and its metabolite – acetaldehyde (Schuz et al., 2015; Kasicka-Jonderko, 2012).

The effect of alcohol on the development of colorectal cancer results from disorders in digestion and absorption caused by ethanol metabolites, i.e. acetaldehyde and acetic acid. They exert an effect on motor and secretory functions of the gastrointestinal system, leading to flatulence and inefficiency of digestion, as well as disorders in the absorption of micro- and macro-components. This results in the deficiency of vitamins which play the role of antioxidants in the human body. In individuals who abuse alcohol, a slowing down of intestinal motility has

been observed, which leads to an excessive development of intestinal flora and its translocation. Ethanol increases the production of nitric oxide, superoxide free radicals and peroxynitrite anions, which enhance the permeability of the intestines by the weakening of tightness of the mucous (Kasicka-Jonderko, 2012).

The WHO classified alcohol beverages, ethanol and acetaldehyde, into important carcinogenic factors (Group 1) and recommended the limitation of alcohol consumption to two drinks in the case of males and one drink for females per day, i.e. 20–30 g of ethanol daily (Schuz et al., 2015; Cancer Prevetion WHO, 2016).

Food components and nutritional habits decreasing the risk of occurrence of colorectal cancer include the maintenance of normal body weight and appropriate consumption of fruits, vegetables and cereal products (Schuz et al., 2015). In the context of prophylaxis of colon cancer, many scientific studies emphasize the role of milk and milk products (Kuczyńska et al., 2013; Cichosz, Czeczot, 2012).

Non-starchy food of plant origin is indicated in the European Code Against Cancer as a basis of diet (Schuz et al., 2015). However, evidence for the presence of the relationship between a higher consumption of vegetables and fruits and the risk of contracting colorectal cancer is not unequivocal. The relation between a reduced risk of occurrence of colorectal cancer and consumption of fruits and vegetables was observed based on scientific reports indicating that this disease is less common among vegetarians than individuals who consume meat (Orlich et al., 2015; Key et al., 2014). The effectiveness of anti-cancer effect in this section of the gastrointestinal tract has been scientifically confirmed only for some groups of vegetables, such as cruciferous plants, to which belong cabbage, brussel sprouts, cauliflower, broccoli, turnip, kale, wasabi (Japanese horseradish), or *Alliacae*, e.g. garlic, onions, leeks or chives (Wu et al., 2013; Wroński, 2013). Cruciferous plants contain glucosinolates, substances which are precursors of compounds which play functions in the protection of cells against DNA damage by carcinogenic factors and reactive oxygen species, and do not allow the development of cancer. Glucosinolates exert an effect on many processes taking place in a cell, such as: regulation of the level of transcription factors, signalling paths, regulation of cell cycle and apoptosis. While exerting an effect on cell cycle, they enable the degradation of cancerously changed cells at early stages of tumour development. Glucosinolates show anti--angiogenic, anti-inflammatory, anti-bacterial and anti-viral effects (Śmiechowska et al., 2008; Zalega, Szostak-Węgierek, 2013).

In turn, plants of the *Alliacae* species contain sulfur compounds, the anti--cancer effect of which is based on the induction of apoptosis in colon cancer. Their bactericidal effect was also confirmed; therefore, the WCRF recommends the daily consumption of fresh garlic (Wroński, 2013).

Although there is no unequivocal evidence for a direct relationship between the risk of contracting colorectal cancer and general consumption of vegetables and fruits, their indirect effect may be proved, i.e. that they eliminate factors which are conducive for the development of this disease. Due to the content of dietary

fibre they have a low energy density, even with a higher volume, thus resulting in the maintenance of normal body weight. Also, dietary fibre favourably affects the motility of the colon and prevents the stagnation of gastric contents in this section of the gastrointestinal tract. The stagnation of food results in a long-term contact of intestinal walls with secondary bile acids, which exert a negative effect on colon cells (colonocytes) (Doyle et al., 2012). It has been confirmed that especially deoxycholic acid affects necrosis, hyperplasia, and induction of DNA damage of cells (Renehan et al., 2012). Fibre is also a natural medium for favourable bacterial flora (Szczepańska et al., 2010).

Some vegetables and fruits contain insulin. This is a natural prebiotic occurring in, e.g. chicory, leek, garlic, onion, Jerusalem artichoke, or bananas, which stimulates growth and metabolic activity of some species of intestinal bacteria, which favourably affects the functioning of the gastrointestinal tract. In the large intestine, insulin is subject to fermentation and contributes to an increase in lactic acid and acetic acid bacilli, substances which inhibit the growth of putrefaction bacteria. As a result of the insulin fermentation processes, short chain fatty acids are produced in the colon, including butter acid, causing the destruction of cancer cells (Schuz et al., 2015; Zalega, Szostak-Węgierek, 2013). Similarly, fermented plant products, such as soya, cabbage, or cucumbers, due to the content of lactic acid create the environment favourable for the development of intestinal microflora, capable of synthesising the enzymes which decompose potentially carcinogenic compounds in the lumen of the colon (Zalega, Szostak-Węgierek, 2013).

In vegetables and fruits there are many biologically active substances of confirmed anti-cancer effect, such as: vitamins C, E, and A, and β-carotene, folic acid, selenium, polyphenols, anthocyanins, among others. They may constitute an active instrument in the chemoprevention of colorectal cancer (Schuz et al., 2015).

The benefits resulting from the consumption of vegetables and fruits are considerable. However, this group of products is not excluded from risk factors, which are related with human activity. The problem concerns the preparations such as: pesticides and herbicides used in the processes of growth and storage of plants, as well as aflatoxins. These preparations have been preventively classified as carcinogenic, because they may induce cancerous processes if in these products a proper level of inhibitory factors, such as vitamin C and E, flavonoids and polyphenols is not simultaneously found (Hasik, 2001). However, as a result of human interference, the content of vitamins and minerals in cultivated plants decreases.

Despite the lack of unequivocal evidence for the relationship between higher overall consumption of vegetables and fruits, and a lower risk of development of colorectal cancer, the potential of this group of products in the prevention of the disease is tremendous.

Whole grain cereal products are a rich source of dietary fibre. A negative correlation was found between the consumption of fibre and occurrence of colorectal cancer. In individuals who consume 35 g of fibre per day the risk of development of

gastrointestinal cancer decreases by as much as 40%, compared to those who consume only 15 g of fibre daily (Bienkiewicz et al., 2015).

Dietary fibre from cereals shows a greater importance in the prevention of colorectal cancer than fibre from vegetables and fruits (Schuz et al., 2015).

Dietary fibre is not digested and absorbed in the small intestine. It passes to the colon in an unaltered form, and it is in this section of the gastrointestinal tract that its partial or total fermentation takes place. As mentioned above, fermentation processes stimulate the growth or metabolic activity of some strains of intestinal bacteria. By hydrolysing fibre, the bacteria obtain energy necessary for their own development. Favourable bacterial flora regulates the functioning of the immune system, development of the intestine, production of vitamins (biotin and vitamin K), as well as enzymes. One of the products of fermentation processes are short chain fatty acids: acetic acid, propionic acid and butyric acid. It has been confirmed that these acids affect an increase in the proliferation of colonocytes and apoptosis of cancer cells (Bienkiewicz et al., 2015; Schuz et al., 2015).

A diet rich in whole grain cereal products supplies the body with a higher amount of dietary fibre, which exerts a beneficial effect on the motility of the large intestine. Due to this, gastric content is not retained in the colon, and is passed at a proper speed to the subsequent sections of the gastrointestinal tract, therefore shortening the duration of contact of digested food with the intestinal wall. This prevents constipations which are considered as factors conducive to the occurrence of colon and rectal cancer.

Despite many advantages resulting from the consumption of fibre, the supply of fibre for the maintenance of health should not be excessively high, because it may hinder the absorption of nutrients and the use of mineral components (Bienkiewicz et al., 2015).

Milk and its products are considered as factors of probable protective effect on the large intestine against cancer. Many clinical and epidemiological studies suggest that this group of products is important in the reduction of risk of development of colon and rectal cancer, indicating, at the same time, the need for carrying out further observations (Kuczyńska et al., 2013).

Preventive properties of milk are considered in association with its composition. Milk and dairy products are the source of easily absorbed vitamins and mineral components, as well as short chain fatty acids. Classified into anti-oxidants present in milk are all vitamins soluble in its fats, i.e. vitamins A, D, E and K, which protect cells against reactive oxygen species, and vitamins soluble in water – vitamin C and vitamins of group B. Other strong antioxidants are contained in milk fat (Cichosz, Czeczot, 2012; Kuczyńska et al., 2013).

Calcium present in milk may bind bile acids forming with them insoluble calcium salts, thus deactivating the carcinogenic factor. It also shows a capability for exerting a direct effect on the intestinal epithelial cells, regulating their cell cycle; also limits the growth and differentiation of altered cells (Gałaś et al., 2013).

The high digestibility of calcium from milk is not only due to its high content in the product, but also due to the presence of other biocomponents, including a beneficial proportion of calcium to phosphorus and the presence of vitamins from group D (Cichosz, Czeczot, 2012). Vitamin D also contributes to the inhibition of cancerous processes in the large intestine. An insufficient supply of vitamin D may disrupt the growth and functioning of colonocytes (Olejnik et al., 2010).

In recent studies on the anti-cancer properties of milk, attention is paid to milk fat and contained in it natural isomers *trans*: conjugated linoleic acid (CLA) and vaccenic acid. CLA is considered as the most active anti-oxidant in milk fat which shows an inhibitory effect on the development of cancer cells in the colon (Cichosz, Czeczot, 2012). The anti-cancer effect of this acid in humans was confirmed at a dose of 3 per day. In milk products, its content range between 2.9–30 mg/g of fat, while with such products as yellow cheese or butter, it reaches 385 mg/100 g of fat (Kuczyńska et al., 2013).

Ester lipids, 13-methyltetradecanoic acid, α-tocopherol, coenzyme Q_{10}, and short chain saturated fatty acids also show anti-oxidative and immunosuppressive properties. A great advantage of milk is that the oxidants present in it are very effective, although their number is small. This results from an active co-action of individual compounds, which create a synergistic system where the regeneration of one component may take place at the cost of the other, e.g. coenzyme Q_{10} reconstructs α-tocopherol from the tocopherol radical, whereas α-tocopherol may renew β-carotene. In addition, anti-oxidants of the lipophilic environment supplement the effect of the antioxidant of the hydrophilic environment.

Anti-cancer effect of milk fat within the large intestine also consists in the stimulation of the functioning of the epithelium through short and medium chain saturated fatty acids. These compounds from the diet, as well as those produced by intestinal flora, affect an increase in the growth of colonocytes and apoptosis of cancer cells, and exert a stimulatory effect on motility. In addition, prostaglandins present in milk fat possess a capability for binding bacterial toxins and rotaviruses, thus preventing the development of inflammatory processes in the intestine (Cichosz, Czeczot, 2012).

Milk and its products are also a valuable source of proteins showing a strong anti-cancer effect, to which belong whey proteins and casein (Kuczyńska et al., 2013).

Conclusions

Colorectal cancer belongs to civilisation diseases. This is a diet-related disease, i.e. the risk of the development of the disease is modifiable by means of nutritional habits. The most important dietary factors favouring this disease include: obesity, consumption of red meat, meat products, alcohol, and consumption of products of high GI and GL. The risk of contracting the disease is decreased by: appropriate

consumption of whole grain cereal products, rich in fibre, proper supply of milk, as well as vegetables and fruits in the daily diet.

Colorectal cancer is most frequently diagnosed at older age, in an already advanced stage of the disease. Late diagnosis provides little chance for the effectiveness of the therapies undertaken. The human life span is constantly increasing, which is associated with a higher exposure to carcinogenic factors. Therefore, it is worthwhile using diet as a modifiable carcinogenic factor in order to reduce the risk of development of the disease.

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Role of diet in primary prevention of colorectal cancer

Abstract

Colorectal cancer is a diet-related disease classified by the World Health Organization (WHO) on the third position from the aspect of the number of cases and deaths. The main factors promoting the development of colorectal cancer have been classified as obesity, consumption of red meat and alcohol. It is presumed that implementation of a health education, promoting life style, i.e. an adequate diet, increased physical effort or maintenance of a proper body weight, would result in a significant decrease in the number of new cases of colorectal cancer.

Key words: colorectal cancer, prevention, diet

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Chronic lymphocytic leukemia – clinical course, prognostic parameters, prognostic markers

The pathogenic mechanisms of the hematologic malignancies

In order to maintain the stability of internal parameters of the body there is a necessity of constant cooperation of a large number of mechanisms and factors regulating the immune response. Hematopoiesis is a complex process differentiating all blood cell types from the hematopoietic stem cells (HSC – hematopoietic stem cells). This process is an excellent model for studying the molecular mechanisms that control the fate of cells. The comprehensive analysis of the research is crucial for the development of new treatment techniques. Hematopoietic stem cells have a high capacity for self-renewal and differentiation into the various hematopoietic cell lines. The microenvironment made of inter alia fibroblasts, bone marrow stromal cells, adipocytes, macrophages, and extracellular matrix is necessary for proper hematopoiesis. Growth factors and cytokines produced by bone marrow stromal cells have an impact on the differentiation of HSC. The HSC receptors, by connecting with the surface growth factor, cause the activation and proliferation of the cells (Riegier et al., 2012; Krzakowski, Warzocha, 2013). Abnormal expression and transcription factor mutations, disturbances in the activity of cytokines, growth factors, and deregulation of epigenetic mechanisms of signal transduction are specific for tumor cells of the hematopoietic system (Figure 1) (Krzakowski, Warzocha, 2013). Bone marrow is the primary site of creation and development of blood cells. The multipotent progenitor cells of myeloid and lymphoid lineage are formed from HSC. The way of differentiation into the cells that perform adaptive and innate immune response mechanisms is subject to strict, multi-level control by direct and indirect factors which regulate the production of the cellular components of blood. Myeloid progenitor cell differentiates into a cell line represented by neutrophils, eosinophils, mast cells, basophils, monocytes, erythrocytes and megakaryocytes. The lymphoid lineage is divided into lines represented by cells targeted for T cells, B cells and NK cells (Doulatov et al., 2012).

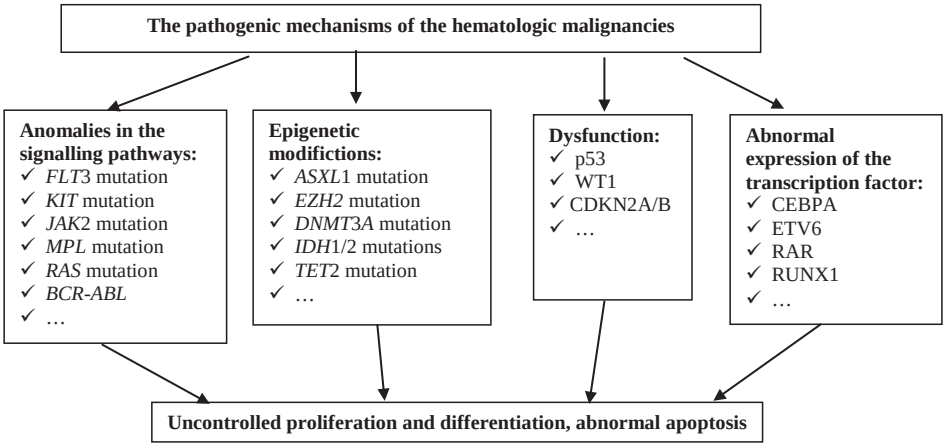

Fig. 1. The pathogenic mechanisms of the hematologic malignancies (Krzakowski M., Warzocha K., *Zalecenia postępowania diagnostyczno-terapeutycznego w nowotworach złośliwych*, vol. II, 2013, p. 658)

Chronic lymphocytic leukemia – the definition, epidemiology, clinical view

Hematopoietic tumors are clonal diseases of hematopoietic stem cells or progenitor cells of the myeloid lineage. Chronic lymphocytic leukemia composes approximately 30% of all leukemia among adults. The essence of the disease is the accumulation and expansion of malignant cells in blood, bone marrow, lymph nodes, liver and spleen. The disease is accompanied by quantitative and qualitative disorders of B cells and T cells. The substantial majority of cells are found in the G0/G1 phase of the cell cycle (Chiorazzi et al., 2005; Hallek et al., 2008). Clinical course and prognosis of CLL is characterized by extremely high variability for individual patients. The survival time ranges from very short to several decades – similar to that of healthy people. Some patients during long-term observations do not require treatment as the disease is mild. While with others, it is a dynamic and aggressive progression of the disease symptoms. This heterogeneity has important implications for the selection of treatment strategies and survival time after diagnosis of the disease (Hallek et al., 2008). The clinical course is often asymptomatic, the diagnosis is often determined by chance on a base of blood count control and evaluation of blood smears. The incidence is 4 per 100,000 people per year, with the incidence growing rapidly with age. Only 14% of patients are less than 55 years old at the time of confirmation of the diagnosis of CLL (Eichhorst, Hallek, 2010). The average age at diagnosis is about 70 years. The diagnosis of CLL is established by the presence in the peripheral blood of ≥ 5,000 monoclonal B lymphocytes/μl for the duration of at least 3 months (Gribben, 2010). The usage of the analytical technique of flow cytometry allows for a qualitative and quantitative assessment of the physical and biological cells. The results obtained from cytometry provide complementary information

to classical hematology tests which allow one to make the required markings of phenotypical lymphocytes. In the case of CLL differentiation, the important matter is the expression of the typical surface markers: CD5, CD19, CD20 and CD23. Bone marrow biopsy is not the most important parameter for the diagnosis, although it is usually recommended prior to initiation of treatment with myelosuppressives, or in the case of diagnostic doubts (Bergmann, Wendtner, 2015). Leukemic cells in the blood smear have an appearance of mature cells. The characteristics of these cells are a narrow hem of the cytoplasm and a compact nucleus. There are also so-called Gumprecht's shadows; the fragments and residues of disintegrated cells (Dmoszyńska, Robak, 2008; Semanaj et al., 2014). In about 5–20% of CLL patients the transformation into aggressive lymphoma may be suspected. The appearance of Richter's syndrome it is usually associated with a very poor prognosis, short survival time and increased resistance to treatment. On the basis of symptoms and clinical changes amongst patients with chronic lymphocytic leukemia, such as fever, substantial and rapid weight loss, increasing organomegaly – enlarged lymph nodes, liver, spleen – night sweats, and elevated lactate dehydrogenase levels (LDH), the transformation into Richter's syndrome may be expected. The gold standard for diagnosis is the histopathological examination – lymph node biopsy (Adamowicz et al., 2008; Zhou, Wan, 2013). Risk factors associated with the development of Richter's transformation in patients with CLL are unfortunately unknown and unidentified. However, many reports in literature confirm that the activation of *C-MYC* gene, mutations in *NOTCH1*, *SF3B1*, *BIRC3* and tumor suppressor gene *TP53*, Epstein-Barr virus (EBV) infection, chromosomal aberrations of leukemia cells such as chromosome 12 trisomy, and chemotherapeutic agents used in the treatment of CLL may increase the risk of Richter's syndrome (Jain, O'Brien, 2012; Ghia, Hallek, 2014; Parikh et al., 2014). A common occurrence is the simultaneous recognition of a second tumor in patients with CLL. Melanoma, sarcoma and lung cancer are the usual coexisting types of cancer. Their treatment is very similar to the treatment in those that occur *de novo* (Adamowicz et al., 2008). In the standards of treatment, polychemotherapy with monoclonal antibodies is mainly used, but unfortunately does not provide long-term remission. Another strategy is allogeneic stem cell transplantation (allo-HSCT) (Eichhorst, Hallek, 2010). Unfortunately, the median age of diagnosis along with the high morbidity and mortality limits the ability to perform allogeneic stem cell transplantation to a small group of patients (Dmoszyńska, Robak, 2008). Before starting the optimal treatment program for patients with CLL, the clinical factors, hematological, immunophenotyping, biochemical and cytogenetics of potential prognostic should be marked. Before taking chemoimmunotherapy or allo-HSCT, certain examinations must be performed, such as virological evaluation of HBV (hepatitis B virus), HCV (hepatitis C virus), CMV (Cytomegalovirus) and HIV (human immunodeficiency virus) and radiological examinations – ultrasound of the abdomen and pelvis, and X-ray of chest. These tests are performed with the intention of establishing the aggravating factors that can affect the response to the treatment

(Elhefni, 2013). Differential diagnosis of CLL compared with other lymphomas having immunophenotypical and cytogenetic abnormalities are shown in Table 1.

Tab. 1. Immunophenotypic and genetic features of other B-cell lymphomas that may be confused with CLL (Gribben J.G., 2010, *How I treat CLL up front*, Blood 14, 115(2), 187–197)

Neoplasm	sIg	cIg	CD5	CD10	CD23	CD43	Cyclin D1	Bcl-6 protein*	Genetic abnormality (%)	IgVh genes
CLL	+	–/+	+	–	+	+	–	–	del 13q(50); del 11q(20); trisomy 12(20); del 17p(10)	50% unmutated
LPL	+	+	–	–	–	–/+	–	–	t(9;14)-*PAX5R*	mutated
MCL	+	–	+	–	–	+	+	–	t(11;14)-*BCL1R*	unmutated (rarely mutated)
FL	+	–	–	+	–/+	–	–	+	t(14;18)-*BCL2R*	mutated, ongoing
Extraodal and nodal MZL	+	–/+	–	–	–/+	–/+	–	–	trisomy 3; t(11;18)-*API2/MLT*; t(1;14)-*BCL10R*	mutated, ongoing
Splenic MZL	+	–/+	–	–	–	–	–	–	del7q21-32(40)	50% mutated

LPL indicates lymphoplasmacytic lymphoma; MCL – mantle cell lymphoma; FL – follicle center lymphoma; MZL – marginal zone lymphoma

+, more than 90% positive; –/+, less than 50% positive; and –, less than 10% positive

* Residual GC may be + in MZL, MCL

The clinical course and prognostic factors

The clinical (e.g. age, sex, co-morbidities) and biological (e.g. aberrations and genetic mutations) parameters in patients with CLL are inhomogeneous. The most important phenomena underlying the pathogenesis of CLL is the inhibition of programmed cell death. To assess the severity of CLL, two standards developed in 1970 are used interchangeably – classifications by Rai and Binet. They take into account both clinical and laboratory parameters. One of the first and the most important achievements of the supplementary classification scheme by Binet/Rai was the development of the molecular cytogenetic technique FISH – fluorescence in situ hybridization. This method allows to routinely detect genetic aberrations in CLL cells (Mertens, Stilgenbauer, 2014). Clinical stage CLL evaluated on the basis of the classification of Rai and Binet is the basis of the guidelines for the decision of whether to start treatment. Both of these systems are essential for the assessment of prognosis and are widely used in clinical practice. The Rai classification system is more popular in North America, while the Binet classification system is more popular in Europe. The disadvantage of these classification systems is their failure to take into account disease progression or response to treatment (Parker, 2011). Classification by Rai and Binet is presented in Table 2. The system presented

by Rai takes into account the laboratory parameters such as lymphocytosis in peripheral blood and bone marrow and the number of platelets and red blood cells in a given stage. Classification of Binet is based on the class of lymphatic areas, the concentration of hemoglobin and the number of thrombocytes. Lymphatic areas are groups of lymph nodes: cervical, axillary and inguinal, as well as splenic and liver. Both systems include the median survival time (Sagatys, Zhang, 2012).

Tab. 2. Rai classification and Binet staging systems for CLL (Gribben J.G., 2010, *How I treat CLL up front*, Blood 14, 115(2), 187–197)

System		Clinical features	Median survival, y
Rai stage (simplified 3-staged)			
	0 (low risk)	Lymphocytosis in blood and marrow only	>10
	I and II (intermediate risk)	Lymphadenopathy, splenomegaly +/- hematomegaly	7
	III and IV (high risk)	Anemia, thrombocytopenia	0.75–4
Binet group			
	A	Fewer than 3 areas of lymphadenopathy; no anemia or thrombocytopenia	12
	B	More than 3 involved node areas; no anemia or thrombocytopenia	7
	C	Hemoglobin < 100g/L; plates <100x10g/L	2–4

In everyday clinical practice there is a recommended number of methods and techniques to be the most optimal for the diagnosis of CLL. Biochemical parameters are easy to determine and allow for the assessment of activity and severity of disease in individual patients. Important markers of the proliferative activity and risk of progression in the serum of patients with CLL are inter alia, β-2-microglobulin (β-2-M), the level of soluble CD23 receptor (sCD23) and thymidine kinase (TK) (Cramer, Hallek, 2011). β-2-microglobulin is a 12kD protein associated with histocompatibility antigens, as a component of MHC class I molecules (Lisowska--Myjak, 2010). B-2-microglobulin is identified as a reliable prognostic marker for estimating survival time without treatment (TFS; treatment-free survival) and overall survival (OS) in patients with CLL. The simultaneous analysis of the level of this protein with the glomerular filtration rate is a clinically important parameter (Delgado et al., 2009). TK activity in patients with CLL reflects the proliferative potential of the malignant clone, and is a valuable addition to the diagnosis of CLL. Mutations of the immunoglobulin heavy chain variable genes (*IGVH*) and ZAP-70 expression is closely related to the high activity of thymidine kinase (Konoplev et al., 2010; Magnac et al., 2013). The stage of development of chronic lymphocytic leukemia and the forecasting of overall survival correlates with the level of sCD23. CD23 is a transmembrane glycoprotein on the surface of B cells with low affinity for immunoglobulin E (IgE). CD23 protein is unstable, and it is present in its soluble form in the serum. In CLL patients, the level of sCD23 is significantly higher than

in patients suffering from other diseases of the lymphatic system and healthy individuals. Doubling the level of sCD23 correlates with advanced stages of the disease and increases the risk of a more aggressive course of CLL. The concentration of sCD23 in the plasma is determined by ELISA (Meuleman et al., 2008; Kaaks et al., 2015). Markers of immunophenotype – ZAP-70, CD38 *IGVH* genes mutations, chromosomal aberrations characteristic of leukemia cells, are clinically significant in new clinical practices. ZAP-70 is a cytoplasmic protein tyrosine kinase (PTK), which was originally identified in T cells. ZAP-70 plays a key role in the maturation of T cells and its presence has not been observed in normal B cells. ZAP-70 may be a stronger risk factor for aggressive CLL than the lack of somatic hypermutation *IGVH*. There is no other mutation in the *IGVH* gene which correlates with a worse prognosis and a more aggressive course of the disease. The importance of ZAP-70 expressions as a prognostic factor is the confirmation of the need of evaluation in the routine diagnosis of patients with CLL. Based on the evaluation of ZAP-70 expression, it is possible to distinguish a group of patients with a worse prognosis at an early stage of the clinical disease. The expression of ZAP-70 can be determined by flow cytometry or immunocytochemistry technique (Burger, Chiorazzi, 2013). Numerous scientific reports suggest a relationship between clinical CLL and the activity of pro-apoptotic signaling pathway phosphatidylinositol 3-kinase – PI3K. Cytokine signals from the microenvironment affect the regulation of differentiation and maturation of B lymphocytes. The activity of PI3K is also connected to the negative selection of autoreactive B cells (Lafarge et al., 2014). Glycoprotein CD38 is a membrane antigen presented on cells derived mainly from the lymphoid lineage. Membrane expression of CD38 is an important prognostic factor and proliferation index in the diagnosis of CLL. Research on the functions of CD38 may help to explore the pathogenesis of CLL and be a suggestion in choosing therapy strategies in individual cases. There is a correlation between CD38 expression and the weakening of response to pharmacological treatment and shorter overall survival time (Malavasi et al., 2011). Simultaneous determination and analysis of factors such as TK, ZAP-70 and CD38 in the early phases of the disease makes it possible to start the cancer therapy and indicates the need for further study of their role in regulating the survival of B-CLL cells (Rivkina et al., 2011).

In literature, there is a constant verification of the usefulness of new prognostic markers. Regulatory T cells (Treg) are currently the subject of research into the pathogenesis and progression of chronic lymphocytic leukemia. The number of Treg cells in the peripheral blood of CLL patients is much higher compared to that of the control samples, and is dependent on the stage of the disease, high levels of LDH, β-2-microglobulin, and CD38 expression. Many authors also indicate the potential role of Treg cells in the pathogenesis of autoimmune cytopenias accompanying CLL. The current knowledge of manipulation of Treg cells may represent a future strategy for the treatment of patients with CLL (Andrzejczak et al., 2011; Arefi et al., 2015).

In recent years, there has been increased attention on the role of molecules of the TNF superfamily in the regulation of cell survival of B-CLL. Proinflammatory cytokines play a special role in the pathogenesis of CLL. In patients with CLL a significant increase in the level of TNF-α in blood serum has been observed. The coupling of elevated levels of cytokines in the serum of patients and anemia in patients with CLL, may suggest a role of TNF in the progression of chronic lymphocytic leukemia. Many authors indicate a close relationship between concentrations of TNF-α in patients with CLL with unfavorable prognostic markers, such as high expression of the antigen CD38 or ZAP-70 protein in leukemic cells. The results of the studies may provide a basis for the use of specific inhibitors of TNF-α because of the control of proliferation of leukemic cells. TNF-α is a factor engaging in the process of cell differentiation and may optionally be used as a predictor of overall survival (Singer et al, 2011; Wasik-Szczepanek, 2012).

Selective inhibitors of nuclear export (SINE)

Adjusting the nuclear-cytoplasmic transport plays an important role in maintaining cellular homeostasis. Exportin 1 XPO is responsible for the transport of more than 200 proteins – mainly suppressor proteins (TSP – tumor suppressor proteins), and growth regulators, including p53, p21, FOXO, PI3K/Akt, Wnt/β-catenin and NF-kB. It is characterized by the overexpression in other hematological malignancies. Small molecule selective inhibitors of nuclear export have been designed to specifically inhibit XPO 1. Exportin XPO 1 was first identified in the early 90s. From experiments it has been shown that the high expression correlated with progression of the clinical course of chronic lymphocytic B-cell leukemia. Overexpression of Mcl-1 prolongs the survival of CLL cells exposed to a variety of apoptosis-inducing stimuli. Mcl-1 is a protein belonging to the Bcl-2 family and acts anti-apoptically. Mechanisms of action and clinical significance of SINE have been analyzed, inter alia, in chronic lymphocytic leukemia. On the basis of preclinical studies, it was found that the lower SINE *MCL-1* in CLL cells produced an influence on the regulation of signal transduction pathways and metabolic pathways in CLL inhibit growth and induce apoptosis of CLL cells, which usually do not respond to conventional therapies. In the search for new therapeutic solutions, drugs that selectively inhibit nuclear exportins are now arousing interest (Lapalombella et al., 2012; Das et al., 2015).

According to the analysis of bibliographic data, chronic lymphocytic leukemia is clinically heterogeneous and in most cases an incurable disease, which is why a breakthrough in the effectiveness of the treatment is very important and awaited. Monoclonal antibodies have contributed to substantial progress in the treatment of chronic lymphocytic leukemia. In some cases the use of the therapeutic strategy can result in long-term remission, while in other patients there has been observed a high resistance to the applied therapy, and an aggressive course of disease progression. Due to the high probability of Richter's transformation, special attention is required

from clinicians. Early detection and diagnosis of a second cancer plays a key role in achieving therapeutic success. In recent years, rapid development of test methods, more accurate understanding of the biology of the disease, careful evaluation of clinical experience and numerous scientific papers on the pathogenesis of chronic lymphocytic leukemia have enabled thorough knowledge of many new factors which influence the development and course of the disease.

The diagnosis of cancer is a very difficult and sudden situation that affects a hierarchy of values and aims. Cancer influences rhythm of life, reduces physical activity, worsens mental wellbeing and causes many negative emotions such as: aggression, fear, regret, frustration, uncertainty or shame. Changes occur slowly and simultaneously in various areas of life. There are many factors that have an influence on physical, mental and emotional state of a patient and his family members. A long battle with life-threatening disease is connected with changes in a family system and personal and social life. Cancer may affect the family in a destructive way or, on the contrary, it can motivate to take action. Encouraging the patient to deal with the disease and to treat it in a proper way is very important. The majority of cases confront the family with the necessity of solving emotional and financial problems. The pharmacological help along with psychological assistance, discipline and following doctor's instructions lead to the improvement of treatment outcomes and to the decrease of undesirable effects. Targeting psychological help and undertaking psychological activities supporting patients during each step of therapy, as well as improving knowledge of psychological mechanisms of behaviour play vital role in the disease course.

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Chronic lymphocytic leukemia – clinical course, prognostic parameters, prognostic markers

Abstract

An increase in the number of patients diagnosed with cancer and death caused by malignant tumors has been observed in the world in recent years. The process of tumor formation is very complex and multistage. The pathogenesis of hematopoietic system diseases is mostly associated with anomalies in the signaling pathways, genetic and epigenetic modifications. The gene mutations responsible for DNA methylation and acetylation and methylation of histone proteins play an important role in the formation of hematologic malignancies. Disorders of the basic stages of hematopoiesis may result in uncontrolled proliferation and differentiation, and tumor initiation. Disorders of DNA repair mechanisms, as well as cell cycle deregulation may increase the risk of hematological malignancies. The basic division of hematologic malignancies are by their morphological traits, cytochemical and immunophenotyping of

cells. New reports of specific genetic and molecular disorders may become therapeutic targets and be used to monitor the remission and progression of diseases. Chronic lymphocytic leukemia (CLL) represents about 30% of adult leukemia and is a disease of the elderly people. CLL is usually diagnosed between 60 and 70 years of age, with a male to female ratio of 2:1. The disease occurs more frequently in Caucasians than in the Black and Asians population. The clinical course of the disease usually presents as a chronic condition and is very diverse. The deregulation of the immune system is manifested by reduced resistance, and the possibility of the emergence of autoimmune processes depends on the degree of development of the cancer. In most cases the therapeutic goal is to achieve complete remission and overall survival. Mutations of the immunoglobulin heavy chain variable genes (*IGVH*), blood biochemical markers, antigen CD38 and ZAP-70 expression and chromosomal abnormalities are amongst the most important prognostic parameters in CLL. The main objective of this review is to attempt to summarize the current information on clinical symptoms identified by genetic abnormalities and prognostic markers among patients with chronic lymphocytic leukemia.

Key words: pathogenesis of CLL, prognostic factors, chromosomal abnormalities

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Phenomenon of ageing – a process or a state

The problem of ageing is among the oldest research problems. Long ago in the 1st century B.C. Marcus Tullius Cicero said: "[…] when I reflect on this subject I find four reasons why old age appears to be unhappy:

- it withdraws us from active pursuits;
- it makes the body weaker;
- it deprives us of almost all physical pleasures;
- it is not far removed from death."

The considerations of Cicero concerning passing away and death still remain up to this day. Until today, despite the development of science, many questions concerning the ageing of the body remain unanswered. There has even developed a separate scientific domain dealing exclusively with the aging of organisms – gerontology. The term is derived from Greek: *geron* – meaning "old man" and *logos* – meaning "study" or "word".

Many researchers have attempted to suggest the definition of ageing. One of them defines ageing as progressing with the age of the body decline in its capabilities for self-repair of growing intracellular damages. There occurs a gradual extinguishing of life functions, this process cannot be avoided, although it may last for varying lengths of time. In Europe and the United States of North America, the average life span is 75 years, while in some regions of the world, e.g. in Georgia or the Andes, people can live up to 110–120 years. Therefore, the world population constantly increases. In 1950, it was 2.5 billion, in 2009 this number exceeded 6.7 billion, whereas the prognoses for 2050 show an increase up to 9 billion. It is an alarming fact that the elderly will constitute a considerable percentage. This is due to an increasingly more effective prophylaxis and a considerable decline in birth rate. The average life span increased from 45 years in 1900 up to 75 years at present. This growing number of the elderly poses a great challenge for the future. Together with age, there decreases not only the condition of the body, but also physical efficiency and cognitive functions. Ageing is also associated with an increased risk of so-called age-related diseases.

Thus, the elderly should be provided with appropriate care. The problem of ageing is no longer a scientific problem, but has also become a social problem. Therefore, it is very important to quickly and precisely recognize the causes and mechanisms of the process of ageing on all levels of biological organization of the body, starting with cellular structures, through the entire cell, tissues, and individual organs of all systems – the cells lose their replication potential, cease to divide and are ageing.

Ageing on the cell level

Since the 1960s, it has been known that cells are ageing, which was indicated by Leonard Hayflick and Paul Moorhead (1961) who confirmed that cells *in vitro*, although having undergone a specified number of divisions, cease to divide, but do not die. They lose their replication potential; however, for a long time they may preserve their metabolic activity.

During the process of ageing, the total number of cells within their populations decreases, which is clearly observed, e.g. among the cells of the central nervous system and in the population of liver cells – hepatocytes. In the ageing cells, a decrease is noted in capabilities for proliferation, e.g. among fibroblasts (Bayreuther et al., 1988; Norwood et al., 1990).

In the cellular membrane an increase in the concentration of cholesterol is observed accompanied by a simultaneous decrease in the content of phospholipids, resulting in an increase in stiffness and viscosity of membranes, a decrease in their flexibility which, in consequence, may lead not only to a decreased rate of lateral diffusion of plasma membrane components, but also a hindered flow of information signals to the cell. Such phenomena may be observed in enterocytes of the intestinal epithelium and epithelium of the prostate, as well as in the membranes of neurons, hepatocytes and cells of skeletal muscles, lipocytes and thrombocytes from older individuals (Viani et al., 1991; Wahnon et al., 1989; Watała, 1991; Wood, Schroeder, 1988; Yegutkin et al., 1991). In the cellular membrane a rapid decrease is noted in the amount of cell receptors, e.g. β-adrenergic receptors on the surface of neurons of the heart muscle cells (Roberts, Steinberg, 1986; Sprent et al., 1991).

In the ageing cells changes in the cytoplasm take place. Cells lose considerable amounts of water; therefore, the tissues become less flexible. This is most clearly observed in the skin, muscles, and blood vessels. Changes are observed in the fine structure of mitochondria. The density of their matrix decreases and the crista become shorter. These structural changes lead to functional changes, e.g. in old rats it was observed that mitochondria of the heart muscle cells are more sensitive to decreased oxygen pressure in breathing air than the mitochondria of the heart of young rats.

It is known that the most materially stable cell component is its DNA located in the nucleus. However, there are many environmental factors which may cause damage, such as radiation, or specific chemical substances. These lesions could be of permanent character if it was not for the capabilities for cell repair in the form

of specific enzymes, so-called polymerases. Together with age, the repair apparatus is subject to damage; therefore, the number of ruptures and damage to the DNA strand clearly increases, and a larger amount of damaged DNA stretches accumulate in the cell. This is especially clear in the nuclei of the cells of the brain, liver and heart. Many researchers presume that it is for this reason that old cells have smaller chances for survival due to the accumulation of damages and abnormalities in the DNA strand. Changes in the structure of DNA lead to errors in the replication of protein molecules. If the number of errors in translation exceeds the capabilities of the cell – which takes place at an older age – its death occurs due to structural and functional disorganization.

During ageing, not only the pace of DNA damage increases, but its interaction to chromatin proteins also changes. With age, the strength of DNA binding to these proteins increases by a change in the electrical charge of proteins, and as a result of water loss. The level of chromatin condensation changes, it becomes more dense, which hinders transcription.

The ageing of the body depends not only on changes taking place on the cell level. At present, there are many documented anatomical and physiological observations which describe changes in individual systems during the ageing of the body (Austad, 2012; Couteur et al., 2012; Lopez-Otin, 2012).

Nervous system

It seems that the consequences of ageing of the nervous system, and of the brain as the organ controlling the whole body, are especially important. With age, there occurs a decrease in brain mass, thickness of the cortical plates, as well as the amount of myelinated nerve fibres. For a long time, it has been considered that the ageing of the brain is associated with the death of neurons. Studies conducted in recent years have shown that physiological ageing does not lead to clear changes in the number of neurons in the brain (Morrison, Baxter, 2012; Pakkenberg, Gundersen, 1997; West et al., 1994). Nevertheless, clear changes are observed in the morphology of neurons. A decrease is observed in the volume of neuronal bodies, in the number of branches of dendrites, and a decrease in the number of dendric spines, which leads to decreased communication between neurons (Bertrand et al., 2011). In addition, a decrease is noted in the capabilities for neurogenesis (Morrison, Baxter, 2012). However, these changes are not equally intensified in all structures of the brain. The frontal lobes shrink most strongly, which may result in difficulties with concentration and decreased abilities for focusing attention on several things at the same time. The hippocampus, the structure engaged in learning and memory, is subject to especially big changes. Also in the cerebellum, a rapid decrease occurs in the number of Purkinje cells, which in older individuals causes difficulties with locomotion, maintenance of balance and proper body posture.

The effectiveness of receptors decreases, reaction time prolongs, and the speed of voluntary movements decreases. A decrease is noted not only in the number of

connections between nerve cells, but the changes also concern the sole motor plates. The endings of axons shorten and do not reach many receptors, the field of terminal branches considerably decreases, there occurs fragmentation of the connections, a decrease occurs in the number of synaptic vesicles and, consequently, a decrease in the amount of transmitters reaching the synaptic cleft during stimulation.

Endocrine system

With age, a gradual and irreversible deterioration is observed in the functioning of the endocrine system, which is considered to be responsible for the stimulation of changes associated with ageing. It starts to respond increasingly more weakly to changes in the environment, and the secretory activity of endocrine glands clearly decreases (Arlt, 2004; Chahal, Drake, 2007; Djahanbakhch, 2007; Midzak, 2009; Peeters, 2008). This is especially clearly observed in the example of testes in males and the level of testosterone in their blood. It is known that over 95% of testosterone is produced in the Laydig cells in testes. With age, the number of these cells decreases by more than 40% in males aged between 50–76. Characteristic changes are observed in their structure. There occur many vacuoles, lipofuxine grains accumulate, and the number of nuclei may even increase (Bilińska et al., 2009; Chen et al., 2009). In this way, the changed cells produce increasingly less testosterone. It was confirmed that between the ages of 55–68 of life, the level of testosterone decreases by 1.4% annually (Perheentupa, Huhtaniemi, 2009).

The ovaries are also subject to ageing processes, and over the years they produce increasingly less ovarian follicles. Simultaneously, there occur disturbances in the secretion of hormones. An increase is noted in the level of the follicle-stimulating hormone (FSH) and luteinizing hormone (LH) in blood (Tatane et al., 2008; Djahanbakhch et al., 2007).

In older individuals, a very clear decrease is observed in the levels of oxytocin and vasopressin produced by the hypothalamic neurosecretory cells which flow via neurons to the posterior lobe of the pituitary gland, where they are stored.

It is an interesting fact that the secretion of thyroid gland hormones remains on a constant level throughout most of life. As late as over the age of 60 a decrease in hormones concentration is observed, but only of triiodothyronine (T_3), whereas the level of thyroxine usually remains unaltered. Changes also concern the sole thyroid gland. The degradation of the secretory epithelium, decrease in the volume of follicles and overgrowth of the connective tissue are only some of the changes exerting an effect on a decrease in the secretory function of the thyroid gland. The activity of parathyroid glands also changes, resulting in a decreased secretion of calcitonin, which leads to osteoporosis.

Over the years, the concentration of growth hormone somatotropin (GH) in the blood clearly decreases as a result of decreased secretion of samatoliberin and increased secretion of somatostatin (O'Connor, 1998). Toogood (1996) reported that the mean concentrations of somatotropin in individuals aged 65–85 are by half

lower than in young people. In old individuals, the adrenal glands, especially their cortex, behave in an interesting way. The reticular and glomerular layers may disappear, while the fascicular layer increases. Also, the function of adrenal glands changes with age because of a decrease in the synthesis of adrenal androgens, whereas the synthesis of cortisol does not change. Similarly, for many years, much attention has been devoted to the role of dehydroepiandrosterone (DHEA) in the body. This hormone, synthesized in the reticular layer of the adrenal cortex, has been called by some researchers a "hormone of youth", because it was presumed to play a key role in the ageing process (Allolio, Arlt, 2002; Baulieu, 1996). Dehydroepiandrosterone belongs to neurosteroids, i.e. steroids synthetized directly within the central nervous system, which exert a modulatory effect on nerve conduction (Baulieu, 1998). From among all the steroid hormones, DHEA shows the highest concentration in blood: 10–15 times higher than cortisol, 100–500 higher than testosterone, and as many as 1,000–10,000 times higher than estradiol (Allolio, Arlt, 2002; Kroboth et al., 1999). The level of DHEA shows clear age-related differences. The peak values are manifested at the ages between 25–35; subsequently, these values considerably decrease and at the age 60–70 they are only 10–20% of the value occurring in 30-year-olds (Belanger et al., 1994). It has even been suggested that the concentration of DHEA may be considered as a marker of physiological ageing (Dharia, Parker, 2004; Yen, 2001).

According to the latest theory, melatonin, the level of which begins to decline from the age of 40, is considered as a hormone preventing ageing. A decrease in the secretion of melatonin by the pineal gland may be the result of the accumulation of calcium deposits in the pinealocytes, as well as a decrease in the number of β-adrenergic receptors on the surface of their membranes (Hadley, Levine, 2007; Karasek, 2007). The inhibitory effect of melatonin on the development of senile changes in various organs results from its antioxidative, free radicals sweep off properties, and anti-stress action, because the accumulation of lesions caused by free radicals is considered as one of the causes of the process of ageing of organisms.

Cardiovascular system

The process of ageing leads to structural, functional and biochemical changes in the cardiovascular system. Changes taking place in blood vessels concern the endothelium of the vessels. An impairment of metalloproteinase and angiotensin activity, an increased collagen synthesis, accumulation of cholesterol and lipoproteins deposits, lead to a decrease in the number of elastic fibres, and intensification of the processes of fibrillation and calcification (Rajzer, 2003; Rajzer, Kawecka-Jaszcz, 2007). Blood vessel walls are subject to thickening and subsequent narrowing, resulting in a decrease in their lumen, which makes them stiffer. The effect of considerably decreased susceptibility of large arterial vessels are primarily age-related changes in arterial pressure, leading to an increased aortic pulse wave velocity, resulting directly in an increase in systolic pressure (Graham, 2007; Kocemba, 1998).

The majority of changes taking place in the heart are related with the state of blood vessels; the heart must now overcome a higher resistance to blood flow, which causes a great loss of energy during the contractions of the heart muscle. The amount of blood pushed by the left ventricle into the aorta decreases, resulting in a smaller number of heart contractions. The time is prolonged in which blood fills the atria of the heart, reaches the lungs and other parts of the body, and the stroke volume also decreases. The changes taking place in the heart are of a morphological and functional character. As a result of apoptosis and necrosis, the number of cardiocytes decreases, which leads to an overgrowth of the remainder. Stimulated cadiomyocytes capture a smaller amount of calcium, which results in a decreased capability of the heart for systole and prolongation of the time of diastole (Siddiqi, Sussman, 2013). Depositions of amyloid and lipofuscin in the heart muscle lead to an increase in the thickness of its walls and loss of flexibility (Besse et al., 1994). In the cardiac stimulation-conduction system a decrease occurs in the number of peacemaker cells in the sinoatrial node, while the remaining structures are subject to calcification. Subsequently, there occurs disorder in the electrical activity of the heart (Sungha, 2007).

Muscular system

Analysis of the structure and function of skeletal muscles indicates that a relative stability of their development takes place as late as at the age of 20. Over the years, there occurs a loss of muscle mass (sarcopenia), and an accompanying loss of muscle strength (dynapenia). These are typical symptoms of ageing of the body.

It is known that a motor unit is the basic functional element of the skeletal muscles. It is composed of muscle fibres innervated by axon terminals of the same motor neuron, i.e. motoneuron. In the process of ageing of muscles there participate neurogenic and myogenic factors. Many reports indicate that the most important factor leading to sarcopenia is a gradual degradation of the nervous system supplying muscles. There occurs a loss of α-motoneurons, resulting in a loss of motor units. This process manifests at the age of over 60. It was found that between the ages 20–90 in the lumbar region of the spinal cord, approximately 25% of motoneurons disappear. The loss of motoneurons has very serious consequences. It leads to the demyelination of axons, which is associated with a decrease in the number and diameter of axons innervating the muscle. The loss of the myelin sheath and decrease in the diameter of axons lead to a decreased conduction velocity in all fibres of motoneurons. These changes in muscles innervation exert an important effect on their activity. In older individuals, a decrease is observed in the excitability of muscles, decreased lability, i.e. the number of responses to stimuli per second, chronaxie is prolonged – time of muscle response to a stimuli. In certain periods of ageing, the thickness of muscle fibre decreases. According to Wolański (2005) the diameter of the fibres of the thoracic muscle in an individual aged 50 ranges within

20–25 μm, at the age of 70 it decreases to 20 μm, while at the age of 80 it is only 10 μm. The loss of muscle mass and velocity of shortening of muscle fibres are the main cause of a decrease in muscle strength. It has been confirmed that between the ages of 50–70, muscle strength is reduced by approximately 15% per decade, compared to the strength observed in young people. After exceeding the age of 70, the loss of muscle strength is about 40%, whereas at the age of 90 muscle strength is by as much as 50% lower, compared to young individuals. Interesting changes are observed in the sole myocytes. In the sarcoplasm there occurs a considerable amount of so-called fatty vacuoles, which replace the disappearing contractile fibrils. There are several causes of the degradation of myofibrils – lack of stimulation on the part of the nervous system, deteriorating blood supply, and a decrease in the efficacy of mitochondria. Fatty vacuoles cause disorder in the course of contractile fibrils. Myofibrils, which to-date have been ordered parallel with respect to each other, begin to separate from one another and take a skew or spiral form, which considerably decreases the strength of contraction. In the muscle cell, a decrease is observed in the intracellular concentration of Ca^{2+} (Safrey, 2014), disorders in the synthesis of actin and myosin (Gannon et al., 2009), and an increase in the synthesis of myostatin – a protein important in the pathogenesis of sarcopenia, limiting muscles development (Baumann et al., 2013). In addition, these cells have a limited capability for glucose uptake and oxygenation. In these cells, a decrease is observed in the efficiency of the process of β-oxidation of fatty acids, there also occurs the accumulation of mitochondrial protein carbonyls and a decrease in the production of ATP, which leads to disorders in the process of cellular respiration (Demontis et al., 2013; Nehlin et al., 2011).

Immune system

During the ageing process there also occurs impairment of the immune system. The most important change in the functioning of the immune system of an ageing body is a gradual thymic involution. However, the cessation of its biological activity, leading to a decrease in the production of T lymphocytes, is not associated with a considerable decrease in immunity, because the body develops well in advance a sufficiently large population of T cells (Weksler, Szabo, 2000). Thus, with aging, no decrease is observed in the overall number of lymphocytes; however, there is a change in proportions between individual groups of these cells and their activity in the organism, which delays the process of formation of humoral and cellular response (Vallejo et al., 1998). There occurs a decrease in the capability of B lymphocytes for the production of natural antibodies, while the production of antibodies against own proteins becomes intensified. Thus, the effect of impaired functioning of the immune system is attacking the body's own cells by lymphocytes, the process called autoimmunoaggression.

Contrary to common opinion that ageing is the time following maturity, the process of ageing of the body starts at the very beginning of the life of an organism

and, according to many factors, takes place at a varied pace. The speed and pace of ageing depends, to a large extent, on the genetic factor determining the duration of life. External factors also exert an effect on the speed of ageing, such as: inadequate nutrition and inappropriate life style, past diseases, contaminated, ecologically devastated environment, and work in hazardous conditions (mining, metallurgy). It is obvious that this process is inevitable and irreversible. Attempts to halt or reverse the ageing process have accompanied humanity from the dawn of time. Unfortunately, together with the development of knowledge, dreams about longevity become increasingly more distant.

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Phenomenon of ageing – a process or a state

Abstract

Ageing is defined as decline in organism's capabilities for self-repair of growing intracellular damages progressing with the age of the body. There occurs a gradual extinguishing of life functions. This process cannot be avoided, although it may last for varying lengths of time. The problem of ageing is no longer a scientific problem, but has also become a social problem. Therefore, it is very important to quickly and precisely recognize the causes and mechanisms of the process of ageing on all levels of biological organization of the body, starting with cellular structures, through the entire cell, tissues, and individual organs of all systems – the cells lose their replication potential, cease to divide and are ageing.

Key words: ageing, cell, brain, hormones

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Multiple myeloma – cancer among elderly people

Epidemiology and etiopathogenesis of multiple myeloma

Multiple myeloma is the second most common hematological cancer. This represents 1–2% of all malignant tumors and 12–15% of hematologic malignancies occurring in humans. Morbidity level in Europe is 4–6/100,000 cases per year. It is rated that every year in Poland we have about 1,500 new cases of multiple myeloma and unfortunately the number is growing every year. Multiple myeloma occurs more often (about one and a half time) in men than in women, and two times more often in black people than in caucasian people. It does not occur in children and rarely in people below 30 years of age. Majority of cases (90%) occur in people over 50 years of age and the median age at the time of diagnosis is 65–70 years (Becker, 2011; Dmoszyńska et al., 2011; Jamroziak, 2013).

Plasmacyte growth is the consequence of lymphocyte B differentiation, which mainly occurs in the lymph nodes. The process of line B cells growth can be divided into two stages: "antigen independent" and "antigen dependent" (Klein et al., 2011).

Stage one of lymphocyte B growth takes place in bone marrow, where immunoglobulin gene rearrangements occur – initially heavy chain, and then light chain. Cells shift towards line B and after next stages they ripen to B cells characterized by the present of surface immunoglobulin class IgM kappa or IgM lambda. Cells escape from the bone marrow and start to migrate to multiplication centers in peripheral lymphoid organs – including lymph nodes. B lymphocytes flow to them with blood. After passing into the node, B lymphocytes contact Th lymphocytes, which results in forming of multiplication center known as lymphocytic clump (follicle). This is followed by selection of high affinity immunoglobulin B cells and differentiation of memory B cells (CD20+, CD19+, CD27+, CD38–) and early plasma cells (CD20–, CD19+, CD27++, CD38++) – antigen dependent stage. Differentiation of B cells into plasma cells and memory cells requires serious molecular changes, somatic hypermutation (SHM) and class switch recombination (CSR) (Klein et al., 2011; Beason et al., 2012; Jamroziak, Warzocha, 2015).

Taking into account the clinical symptoms of multiple myeloma, two premalignant variants can be considered, monoclonal gammapathy of undetermined significance (MGUS) and smoldering multiple myeloma (SMM). Also Waldenstrom Macroglobulinemia, POEMS syndrome (polyneuropathy, organomegaly, endocrinopathy, monoclonal plasma-proliferative disorder, skin changes) and amyloidosis, which is a disease that occurs when abnormal protein is deposited in our organs, are all places under monoclonal gammapathy. A common feature of these units is the presence of monoclonal protein in serum and/or urine, or the presence of amyloid deposits in various organs (Walewski, 2011; Beason et al., 2012).

The initial stage of the disease is probably the consequence of chronic antigenic stimulation associated with infections, chronic diseases or exposure to chemical carcinogens and radiation, and consists in the creation of numerous mild plasma clones (Jamroziak, 2013).

MGUS is detected in 3–4% of people aged >50 years, and 5% of people aged >70 years, more often in men. Transformation into more aggressive lymphoproliferative diseases appears to be related with the type of monoclonal protein. Majority of MGUS cases related with the production of IgM is associated with progression to Waldenstrom Macroglobulinemia, and clinical cases associated with the presence of IgA and IgG most often transform to MM, moreover, an MGUS is associated with the presence of light chains. Patients with MGUS do not have any symptoms of organ damage resulting from proliferation of plasma cells (Dmoszyńska et al., 2015; Surowiec et al., 2016).

Smoldering multiple myeloma (SMM), which is an intermediate state between MGUS and advanced stage multiple myeloma, occurs in about 8% of patients in whom the contents of plasma cells in the bone marrow is usually 10–20%, and median of M protein concentration in serum ~3g/dl. More than 90% of the cases has hypogammaglobulinaemia and about 70% of patients have present monoclonal light chains in urine. The risk of developing symptomatic multiple myeloma in these patients is 10% during the first 7 years, and then decreases. As in the case of MGUS, patients with asymptomatic myeloma don't have any symptoms of organ damage, whereas the concentration of monoclonal protein or percentage of plasma cells in the biopsy tissue is higher.

Smoldering myeloma is a heterogeneous group of conditions, from which in some patients quickly, usually within two years, develops symptomatic myeloma, and in a group of patients asymptomatic state will be present for years (Dmoszyńska et al., 2015).

The risk of progression to symptomatic myeloma from the moment of diagnosis of smoldering multiple myeloma is not clear. There have been distinguished several parameters helpful in predicting the risk of disease exacerbating. They are: protein M level (o ≥3 g/dl and/or 10% to 60%), plasma cell percentage in bone marrow, percentage of abnormal plasma cells and presence of free light chains (FLC), lack of expression of heavy light chain (HLC), magnetic resonance disorders (MRI), cytogenetic abnormalities, of IgA isotope and Bencea's Jones proteinuria (Gao et al., 2015).

In addition to the typical form of MM with bone marrow sclerosis there are also rare, localized variants – isolated osseous and extraosseous plasma tumor. Diagnosis is made based on the presence of clonal plasma cells in the tissue biopsy from a single tumor, and by exclusion of other places infiltrated by myeloma. Additionally, we recognize negativly prognosin plasma cell leukemia which is characterized by the presence of plasma cells circulating in the peripheral blood, in the quantity of more than 2x 109/L or/and constituting at least 20% of blood cells (Jamroziak et al., 2013).

In borderline cases, the basis for differentiating between PCM and MGUS may be immunophenotype evaluation.

Healthy plasma cells have immunophenotype: CD38+, CD138+, CD19+, CD45+, CD56– (Jamroziak, Iskierka-Jażdżewska, 2015).

Typical myeloma phenotype is sIg–, CD20–, CD19– (90%), CD38+, CD45– (99%), CD138+, CD56+ (70%). The active form of MM, only in exceptional cases has no malignant phenotype. The elements that differ from the normal plasma cells is usually a reduced expression of CD19 and CD45, as well as increased expression of CD56 and CD138. Differentiation of malignant phenotype, mild and transitive, may therefore have clinical significance. However, we should remember that the commencement of treatment is available only for people with active form of disease, and the percentage of plasma cells in the bone marrow does not affect the decision about treatment. In the smoldering form of PCM risk of disease progression can be assessed by testing the free light chains in serum (SFLC, serum free ligt chains). The ratio of kappa/lambda above 8:1 or less than 1:8 is associated with more rapid progression to full-blown form of PCM (Jamroziak et al., 2013).

The pathogenesis of multiple myeloma is still unclear, but possible causes include exposure to pesticides, radiation, insecticides, organic solvents, dyes and hair coloring products, and other occupational and environmental factors (Beason et al., 2012).

Chromosomal additions, deletions, translocations, are associated with the risk of the disease and almost all of these aberrations are associated with the occurrence of MGUS.

There are two forms of the disease. Hyperdiploidal form, comprising 47–74 chromosomes, resulting mainly in the presence of trisomy of chromosomes odd-numbered 3, 5, 7, 9, 11, 15, 19 and 21, and a small number of translocations. The second non-hyperdiploidal embodiment is characterized by abberations of a hypodiploid with chromosome number ≤44, pseudopodium with chromosome number 45 or 46, and tetrapoidal form in which the number of chromosome is ≥75. These forms are characterized by a large number of coexisting region translocations of heavy chain immunoglobulin genes IgH (locus *14q32.33*) to various proto-oncogenes, among which the most common are located at the locus of the gene CCND1 encoding the D1 cyclin, CCND3 locus encoding the D3 cyclin, gene locus FGFR3 and MMSET, gene locus CMAF and gene MMFB. Summary information on

the gene expression of cyclin D with cytogenetic state of *14q* translocation allowed for the preparation of molecular classification of multiple myeloma, called the TC (Translocation/Cyclin) classification. The division into classes with different molecular classes, multiple myeloma with different prognosis is determined for the cyclin D expression, coupled with an appropriate translocation of IgH or lack of it. *14q* IgH translocation is one of the most frequent chromosomal abnormalities in MM. About 60% of the translocation involves the repeating 5 aberrations: *11q13*, *4p16*, *16q23*, *20q11*, *6p21*, which affect the expression of the corresponding genes, including cyclin D1-D3. Gene overexpression of cyclin D1 and D3 (connected with proper *14q* translocation) has a better prognosis than the over-expression of cyclin D2, coupled to a different *14q* translocation. TC classification, despite the undeniable prognostic value, is not frequently used in clinical practice due to both the low availability and high cost of research. The progression of multiple myeloma is associated with secondary cytogenetic changes, which were mentioned above, and various deletions, among which the most important is a deletion in the range of chromosome 17, leading to the heterozygosity of the p53 gene, which is associated with resistance to treatment. Suppressor gene p53 is considered a very important prognostic factor in multiple myeloma, it is an indicator/marker for predicting transition sharpened disease state. Moreover, deletion of *17p13* is associated with relapse in a short time even after administration of high-dose chemotherapy and shorter survival times after transplantation of allogeneic stem cells. 17 chromosome aberrations: t (4; 14) and t (14; 16) are detected in 85–90% of patients and are associated with a deletion of chromosome *13q14* (Walewski, 2011; Nadiminti et al., 2013; Dmoszyńska, 2015).

Symptoms

Symptoms of multiple myeloma can be in the early stages of the disease confused with a common cold. We can note fever, lack of appetite, weight loss, night sweats and recurring colds. Local propagation of malignant plasma cells in the bone marrow may cause primarily painful osteolytic lesions, as well as anemia, kidney failure, and elevated levels of calcium. Impaired plasma cells release cytokines that stimulate the degradation of bone. These include: interleukin-1b (IL-1), tumor necrosis factor (TNF) – A, B-TNF, interleukin-6 (IL-6), macrophage colony stimulating factor (M-CSF), vascular endothelial growth factor (VEGF), and other cellular growth hormones. All of these cytokines are activators of osteoclasts (OCs) (Dmoszyńska, 2011; Ludwig et al., 2011; Molassiotis et al., 2011; Jamroziak, Warzocha, 2015).

Organ dysfunction subsidiary of PCM described as CRAB (calcium increased, renal insuficiency, anemia, bone lesions) (Jamroziak et al., 2013) – see Table 1.

Tab. 1. Organ symptoms criteria being the base for diagnosis of symptomatic multiple myeloma (CRAB symptoms) (Jamroziak, 2013)

C Hypercalcemia	Corrected calcium >0,25 mmol/l above the upper limit of the reference value or >2,75 mmol/l
R Renal insufficiency	Creatinine concentration in serum >173 umol/l (2 mg/dl)
A Anemia	Hemoglobin concentration of 2 g/dl below the lower reference value or < 10 g/dl
B Bone lesions	Lytic lesions or osteoporosis with compression fractures
Other	Recurrent bacterial infections (>2 in the last 12 months), hyperviscosity syndrome, amyloidosis

Three-digit ESR, osteoporotic changes in spine, the presence of monoclonal protein in Electrophoresis – are the changes that may indicate multiple myeloma. Osteolytic lesions occur in 66% of patients. More than half of the patients reported pain (58%), which guide the patient more frequently to a rheumatologist or orthopedist than hematologist. Bone osteolysis contributes to the occurrence of hypercalcemia, which can manifest itself clinically by: nausea, vomiting, polyuria, hypercalciuria, headaches, and even disturbances of consciousness (Heher et al., 2013).

Modern methods of multiple myeloma diagnosis

Thanks to the development of modern diagnostic techniques it is possible to determine illness changes earlier and more accurate. In the case of plasmacytoma diseases, most commonly used is the magnetic resonance imaging (MRI), and histopathological examination of biopsy tissue, cytogenetic studies or FISH, positron emission tomography (PET), and polyclonal determination of free light chains in serum (FLC, FREELITE).

MRI is a non-invasive imaging method, especially useful for the detection of tissue lesions. This test most commonly determines the level of changes in the spine and other bone tissues. Histopathological examination is a microscopic examination of the cytological material (cell) or histological one (tissue). In this study, we can distinguish two stages. The first stage is to acquire the material by various methods, among others, with biopsy. The second step is the evaluation by laboratory techniques. Fine needle aspiration biopsy (BAC, puncture) BAC is called the method of collection of cellular material (cytology) through a tumor puncture done with a thin needle. Thanks to the reduced communication, which is characteristic by its thread tissue for most cancers, easily aspirated (sucked) into the needle, cells of solid tumors expanding in the depths of tissue. Fine needle biopsy is used to determine the diagnosis of palpable and impalpable tumors.

Cytogenetic studies include evaluation of chromosomes obtained from the cell core. The research aims to determine the karyotype of cells: the number and structure (morphology) of chromosomes in metaphase stage of mitotic cell cycle, or

cytogenetic karyotyping. The test is performed in order to detect karyotype irregularities: quantitative chromosome aberrations: disorders of the amount of genetic material in the cell – aneuploidy, or structural aberrations (changes in the distribution of materials in the chromosome) – such as inversions, deletions, translocations.

FISH (eng. fluorescent in situ hybridization) is a cytogenetic technique to determine the sequence of DNA using fluorescence microscopy. FISH technique allows the quantitative analysis using fluorescence scanning confocal microscope (eng. confocal laser scanning microscope, CLSM).

PET (eng. position emission tomography) is a three-dimensional imaging technique which register changes during positron annihilation. These studies allow an early assessment of metabolic changes in the tissues of patients. The contrast of glucose combined with a fluorine isotope (18F). It is a marker extensively metabolized by cancer cells.

FLC (eng. serum free light chains analysis) is a polyclonal determination of free light chains in serum. This method uses two immunodiagnostic tests using polyclonal antibodies which allow to quantitatively evaluate: free kappa chains (κ) in serum, free lambda chains (λ) levels, and the ratio of one to the other. The test is particularly effective for nonsecretory myeloma (Jamroziak, 2015).

The most common complications

Hypercalcemia is a common metabolic complication of multiple myeloma. This is mainly caused by bone resorption caused by tumor. In patients with impaired renal function, hypercalcemia may be aggravated by decreased excretion of calcium.

Hypercalcemia diagnosis based only on increased levels of calcium in serum is unreliable as the tendency for the binding of albumin circulating calcium can lead to a deficiency of a biologically active calcium. The success of treating MM is prevention related to the treatment of symptomatic hypercalcemia. Appropriate treatment should begin with the intravenous administration of physiological saline, forced diuresis salt, and monitoring of central venous pressure and serum electrolytes. Steroids, which are normally administered to patients, not only have anti-inflammatory action, but also hinder the absorption of calcium and reduced bone mineral density (Ailawadhi et al., 2010).

Another dangerous complication of multiple myeloma is renal insufficiency, and is associated with increased mortality in patients with MM. Different pathogenic mechanisms, some of which result from the action of neurotoxic monoclonal Ig proteins, are independent of protein M deposition. Included as monoclonal gammopathy kidney damage are cylinder nephropathy, glomerulopathies, amyloidosis, hypercalcemic nephropathy, acute and chronic interstitial nephritis, acute gouty nephropathy, nephropathy, hyperviscosity syndrome, direct infiltration of the kidney (Shay at al., 2016; Surowiec et al., 2016).

Diagnostic standard is protein electrophoresis, inexpensive test, which unfortunately has poor sensitivity for the detection of free light chains, and cannot always distinguish between the expansion of the polyclonal or monoclonal light chains of the protein. Test FLC has a much higher sensitivity than electrophoresis, but this is a qualitative test and thus has limited usefulness in monitoring the MM and response to treatment. A novel assay allows the quantitative statement of free light chains in serum, and promotes early diagnosis, and allows for early detection of relapse. New methods of diagnosis of myeloma showed significant progress in reversing the renal failure in some cases and improvement of results (Shay et al., 2016).

Anemia affects about 60%–70% of patients with myeloma. Because of the delayed diagnosis, it may pose even life-threatening danger. The most common is normocytic anemia (deficit of normal red blood cells in the blood). The parameters usually improve with the response to treatment. The use of erythropoiesis--stimulating agents (ESA) on patients should be considered when, despite response to chemotherapy, there was no increase of hemoglobin. During treatment there should be monitored the amount of iron in the blood, prevent the loss of functional iron to support erythropoiesis. Transferrin saturation should be at least 20% and ferritin concentration at least 100 ng/ml (Ailawadhi et al., 2010; Gay, Palumbo, 2010; Jamroziak, 2013).

Clinically, the most characteristic disorder in MM is bone pain caused by osteolytic changes. The number and activity of osteoclasts (OCs) increase in the accumulation of myeloma cells. Produced by stromal cells of the bone marrow/osteoblasts RANKL (receptor activator of nuclear factor-kB ligand), the main molecule in the regulation of normal osteoclastogenesis in response to its receptor RANK (receptor activator of nuclear factor-kB), it stimulates osteoclastogenesison on OCs precursors, whereas OPG (osteoprotegerin) secreted by the stromal cells/osteoblasts bounds RANKL and prevents the interaction of RANKL and inhibits osteoclastogenesis (Zdzisińska, Kandefer-Szerszeń, 2006; Shay et al., 2016). In normal bone tissue homeostasis between RANKL and OPG protein is exactly balanced. In myeloma balance between OPG and RANKL is imbalanced, frequently observed is abnormal production of OPG (Ludwig et al., 2011).

Myeloma cells enhance local osteolysis by increasing the expression of RANKL and reduction in the expression of OPG in the bone marrow, and as a result degradation of OPG bound by tumor cells through Syndecan-1. An additional factor affecting the imbalance of RANKL/OPG and enhancing osteolysis, may include a direct production of RANKL by myeloma cells. Activation of OCs is accompanied by the simultaneous inhibition of osteoblasts osteogenic activity, which are the result of a direct reaction of this cells with myeloma cells, and the inhibitory effect of various elements emitted by the myeloma cells. Restoring the balance between RANKL and OPG not only slows down the resorption of bone induced by the disease, but suppresses growth and survival of myeloma cells (Jamroziak, Warzocha, 2015).

After diagnosing the symptoms of the disease, it is important to start appropriate treatment. Pretreatment often consists of high-dose chemotherapy and bone marrow or bone marrow stem cells transplant. A bone marrow transplant should not be performed at the beginning of treatment, it is better to introduce it at a later date. Adjunctive therapy alleviates the physical and emotional impact of the disease on the patient's life. In this case are used: blood transfusion, analgesics and antibiotics. Patient should also keep adequate physical activity, diet and regular sleep.

Until recently, myeloma was considered a deadly disease. Thanks to modern diagnostic techniques and modern medicine it has become a chronic disease.

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Multiple myeloma – cancer among elderly people

Abstract

Cancer is a state in which your cells divide in an uncontrolled way and acquire different characteristics from typical cells of the affected organ. The uncontrolled cell division is caused by protein coding genes mutation, which participate in cell cycle. A malignant tumour is connected with multiple mutation and this is why the disease duration is long and asymptomatic. Unfortunately, most cases of cancer are diagnosed when the tumour is already identifiable or when the patient shows other disturbing symptoms (Jędrzejak, 2009).

Tumours which stem from bone marrow plasmatic cells belong to a group of rare diseases which involve, among others, plasma cell myeloma (PCM), plasmocytoma, maternally inherited diabetes and deafness (MIDD), and monoclonal gammapathy of undetermined significance (MGUS) (Jamroziak, 2013).

Multiple myeloma (MM) originates from the aforementioned plasma cells which are responsible for the production and secretion of antibodies, as well as humoral immune response. MM is caused by clonal proliferation plasma cells which displace healthy cells and cause gradual bone destruction (osteolysis). Additionally, plasma cells produce pathological monoclonal protein (present in blood or urine), which usually involves class IgG and IgA immunoglobulines. Sometimes, monoclonal protein is not a whole immunoglobulin particle, but only its free light chains.

The illness develops in bone marrow, mainly in the backbone, the ribs and the skull. The name multiple myeloma comes from the fact, that it is a metastatic cancer. MM is not a well known disease, and only 1 out of 50 respondents recognized it.

Key words: multiple myeloma, etiology of multiple myeloma, epidemiology, prognostic factors, genetic mutations, chromosomal abberration

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Functioning of a child with depression in the school environment

The essence of depression as a disease entity

The term "depression" is extremely common in everyday language. It is usually used to name the normal reaction to difficult life situations. It often happens that the young person feels sadness, which is the cause of school failure and personal failure, or unsatisfactory social relationships. Depression as a disease, or other recognized clinically depressive syndrome, is a long-lasting, harmful and serious condition characterized by excessive lowering of mood and other symptoms of mental, behavioral and physical ground. In classifications of medical disorders, depression is placed in the group of mood disorders (affective disorders), depressive symptoms, however, can also be present in these patients, who did not have affective disorders (Turno, 2010, pp. 7–27). Indication of specific differences between ordinary malaise, and actual depression is very difficult. In general, the process is simple short-term depression, which is not accompanied by such a low level until the mood, self--esteem, as in the case of depression (Święcicki, 2002, p. 151).

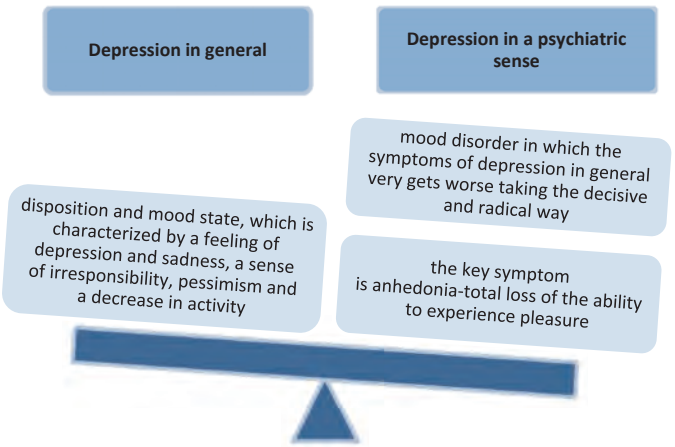

Fig. 1. The definition of depression in general and a psychiatric sense (based on: Reber, 2002, pp. 137–139)

Reber (2002, pp. 137–139) provides a more precise differences. Figure 1 illustrates them.

The International Classification of Diseases and Related Health Problems ICD-10 developed by the World Health Organization (WHO) at positions F32 and F33 place various types of depression – from episodes of disease, to recurrent depressive disorders. None of these units relate directly to children and young people, and therefore the diagnosis of depression in persons of school age is held by the same criteria as in adults.

The clinical picture of depression is largely dependent on the age of a child due to developmental, cognitive, emotional and social transformation. The types of symptoms characteristic of certain developmental periods are presented in Table 1.

Tab. 1. Symptoms of depression specific to the child developmental period (based on: Radziwiłłowicz, 2012, pp. 5–6)

The period of development	Symptoms of depresion
early school age (6–8 years of age)	**Somatic:** fatigue, headaches and stomach disorders, sleep and appetite disorders, bedwetting, poor internalization of social norms, aggressive behavior
	Emotional: refrained from contact with people, avoiding challenges, clinging to parents, fear of going to school, mood disorders (depression, lack of expression of feelings), unwillingness to undertake activities, such as avoidance of fun, reduction of learning capacity
preadolescence (9–12 years)	**Somatic:** sleep disturbances, fatigue, various aches
	Emotional: fear of disease, negative self-image, lying, for example, on the results of the study, existential fear, sadness, anger, blaming himself for causing pain to parents, feeling of lack of love, reticence, hypersensitivity to criticism, rudeness, externalized disorder, thoughts of death
early adolescence	**Somatic:** impaired concentration, feelings of fatigue, anxiety, fatigue
	Emotional: depressed mood, lack of acceptance for your body, tendency to isolation, mood swings, behavior of 'acting out', self-destruction, reduction in the level and the number of activities undertaken
average stage of adolescence (13 years)	so-called depression, resignation or depression with anxiety
	Somatic: lack of appetite, drowsiness
	Emotional: bad mood, excessive sensitivity, a sense of despair and self-destruction, suicidal thoughts
latest age of adolescence	**Somatic:** sleep disorders and cognitive processes
	Emotional: sadness, anxiety, guilt and hopelessness, the rapid reactions to failure and failure isolation, the predominance of negative thoughts on any matter, the impression of lack of understanding, a sense of lack of acceptance, aggressive behavior, alcohol abuse, drugs, medicines, criminal activity, escape from home

The etiology of depression may be associated with biological agents. Transformation of somatic and endocrine (e.g. development of neurobiological system--serotonergic and noradrenergic), the interaction of sex hormones and neurotransmitters, the state of sexual maturity, irregularities in the functioning of the

hypothalamic – pituitary-adrenal and blood-brain barrier, may cause changes in the functioning of the psyche, and the cause or one of the causes of depression (Radziwiłłowicz, 2012, pp. 6–12).

Depression as a social problem

Children and adolescents, like adults are influenced by factors that affect psychosomatic condition. Adults have more mature nervous system and emotional plasticity, as well as better developed system of buffering action of the body, making it easier to oppose the events of fate. Among adults we usually observe developed and related systems of social relations, which enhance the functioning of the position of the entity. Formerly, depression among children and adolescents has been the subject of not enough study, as the dialogue was not carried out with them about their mood or feelings. Even today, if you do not talk to your child about his well-being and problems, we fail to diagnose depression. We now know that both quiet, withdrawn children, and irritable ones may have a depressive problems. A characteristic feature of depression in childhood and adolescence is a high rate of co-morbidity. Most frequently depression coexists with anxiety disorders. 30–75% of children diagnosed with depression at the same time meet the diagnostic criteria for anxiety disorders (Bomba, 2005, pp. 266–279). The report of the World Health Organization shows that by 2020 depression may prove to be one of the greatest dangers to human health and life. Therefore, since 2004, every February 23rd is celebrated as Business Day Against Depression, and since 2006 there is an online course on the portal of Foundation Ithaca "Depression Is a Disease", which aims to inform the public about the disease, its main tenancies and the increasing number of suicides resulting from untreated depression (Radziwiłłowicz, 2012, p. 1).

Causes of depression among children and adolescents

Behavioral disorders of children and adolescents is a problem undertaken by different disciplines – including psychology, pedagogy, neurology, or finally: psychiatry. Such a wide range of interests is evidenced by the complexity of the problem and the need for a holistic explanations of depressive disorders. The problem of depression among children and young people began to occur relatively late in the textbooks of psychiatry, no sooner than the end of the 70s. Depression is one of the most common mental disorders among young people. Rate of depression among people between 9 and 17 years ranges from 0.4% to 8.3%, and it marks the beginning of puberty in boys, and the end of this period in girls (Radziwiłłowicz, 2012, pp. 2–3).

The main reason for the appearance of depressive disorders in children are poor relations between parents. It has been shown that up to 18% of children suffering from depression are those whose parents divorce or are still in a serious conflict. Another common cause is maternal depression, which is due to close relationship

with the child, to whom she involuntarily transfers her pessimistic attitude to the world (Heller, 2012).

It is assumed that the ratio between the number of boys and girls with depression can be determined as 1:2. This is due to the fact that girls perceive their failures or negative events in their physicality, which is often in their subjective assessment unattractive. This leads to low self-esteem and, consequently, to accumulation of negative emotions. The causes of depression are therefore, among other, biological changes associated with human sexuality, learning the essence of gender roles in society and culture, and wrong way to draw knowledge on gender issues (Radziwiłłowicz, 2012, pp. 2–3).

Among other causes of depression, children and adolescents should include:

a) abuse of alcohol or other psychoactive substances by family members,
b) domestic violence,
c) chronic illness of one of the members of the family,
d) psychological, physical, or sexual use by attendants,
e) negligence, lack of interest,
f) low socio-economic statute,
g) excessive control by parents,
h) too high expectations of parents in relation to the child (Turno, 2010, p. 14).

A common cause of depression is stress reactions caused by poor schoolchild. Particularly unfavorable factors include: excessive requirements of discipleship, the difficult situation in the classroom – the atmosphere tension, hostility, lack of acceptance, violence, and school failure. One of the risk factors of depression is low self-esteem resulting from the two inner judgments. After the first child has a certain internal discrepancy between who he wanted to be, and who he thinks he is. The greater the gap, the lower the self-esteem. Another important factor is the self-esteem, which is formed on the basis of relationships with other peers, family, and system presented by the media. It is important, therefore, the support given by adults, as well as the ability to assess the child's behavior and early introduction of therapy (Radziwiłłowicz, Sumiła, 2006, pp. 27–46; Kołodziejak, 2008, pp. 15–33; Link-Dratkowska, 2011, pp. 84–90; Woynarowska, 2012, pp. 407–412).

The mechanism of the development of depression during adolescence is also dependent on biological factors (genetic and endocrine), as well as psychological. Persistence of the disease leads to abnormalities in brain function (Greszta, 2006, pp. 167–185). The risk of depression in children whose biological parents suffered from the disease is 15–45%, even if the child has been adopted by a family free from depressive behavior. If one of the identical twins suffers from depression, the risk of this disorder in the second one is as high as 70% (Hasler, 2011, pp. 5–22).

Among the potential causes of depression are often administered especially endocrine disorders that lead to abnormal reactions in the central nervous system (CNS). Some of them worth mentioning are: a shortage of serotonin, norepinephrine, dopamine, GABA, reduced release of endorphins and disruption of membrane

carriers within neurons. These deficits in a negative way affect the process of communication between neurons, and thus the efficient functioning of the brain. Also, a deficiency of thyroid hormone affects the homeostasis of the body – hence the diagnosis of depression should perform determination of the levels of this hormone in the body. Another factor that may influence the development of depression is the level of cortisol, or stress hormone in the body. Changes in the stress hormone secretion appear to be most pronounced in patients with depression (Landowski, 2002, pp. 9–12). Elevated levels of cortisol can act as a mediator between mental and somatic symptoms, such as the development of type II diabetes (Hasler, 2011, pp. 5–22). Modern concepts of pathogenesis of depression are formulated by using several research strategies. These include studies in animal models, clinical chemistry, neuroendocrinology, as well as post-mortem examinations. But now, using functional neuroimaging methods, we are able to answer many of the interesting questions about the functioning of the brain (Jaracz, 2004, pp. 73–79). Thanks to modern technology, one managed to determine the brain regions whose activity is altered in comparison to healthy subjects. Using, among others, positron emission tomography (PET), single photon emission computed tomography (SPECT) and functional magnetic resonance (FMR) demonstrated that regions such as amygdala, thalamus and hippocampus responsible, inter alia, for memory, emotions and behavior, are statistically lower in patients diagnosed with depression compared to healthy subjects (Jaracz, 2008, pp. 875–888). Stress, which plays a key role in depression, may be a key factor that inhibits the growth of new nerve cells (neurogenesis) in the hippocampus. These studies also showed decreased metabolic activity of nerve cells – including in the frontal lobe, temporal lobe, and the caudate nucleus. We also observed an increased neuronal activity of the limbic system and blood flow disorders in important brain structures, which may affect the subject's cognitive impairment. With the development of histological brain of Alzheimer's, for the first time was demonstrated the relationship between brain pathology, symptoms of dementia, accompanied by other psychiatric disorders. Progress in neurobiology, neuroendocrinology, genetics and neuroimaging methods resulted in the evolution of views on the pathogenesis of depression. System models of the pathogenesis of mental disorders formulated in recent years found that the structure and function of the brain shape the interaction of genetic, somatic, and life experiences. Recent studies also indicate a disturbance of biological rhythms occurring in people with depression (Gawlik et al., 2006, pp. 171–178; Rybakowski, 2008, pp. 133–140).

The consequences of the appearance of depression in young people

A child with depression exhibits very low skills in making interpersonal judgements, due to the ongoing for a long time pessimistic attitude both to himself and environment he lives in. It causes, in turn, to have a very small number of friends, or lack of them, which in the longer term may lead to poor academic performance and lack of success in the school environment (Heller, 2012). In addition, depressive

disorders which begin in adolescence can result in very serious consequences in the form of addictions, psychosis, social phobia, and eating disorders (Drake, Cimpean, 2011, pp. 141–150).

The type of depression that affects young man depends on his behavior, and leads to different consequences of the disease. Types of depression and their effects are illustrated in Table 2.

Tab. 2. Types of adolescent depression (based on: Kępiński, 1985, pp. 25–60)

Type of depression	Consequencess of the illness
apathetic	disintegration of contacts, lack of mobilization to make the effort, unwillingness to play among their peers, neglect of science
	occasionally interrupts the emptiness of life: getting drunk, transgressions of hooliganism, sexual episodes
rebellious	stricter 'youthful rebellion' against the older generation, discharging emotions through aggressive behavior or malice, self-injurious behavior: self-mutilation, alcoholism, suicide
	rebellion against social obligations and hooligan attitude are often an attempt to mask the inferiority complex and lack of self-confidence
negating	severe lack of faith in their own abilities and fulfilling their dreams, resulting in indifference and resignation of dealing with future plans
lability of mood	mood swings so far-reaching that it prevents the patient from living

Care for a pupil with depression and prevention in the school environment

Parents who have noticed in their child alarming symptoms indicating depression should talk with teachers and pediatrician. Unfortunately, both the first and the second professional group needs training in diagnosing depression in young people (Heller, 2012).

An important aspect in the field of school activities seems to be the prevention of diseases and mental disorders among students. It should include in the first place prevention of the occurrence of such diseases by eliminating their causes and relative risks of their formation, as well as education about mental health, or exercise in terms of overcoming stress. The second field of school activities should include early diagnosis of disorders and intervention as soon as possible. The third aspect of the action is preventing the recurrence of the disease, which can be achieved by preventive therapy and psycho education (Drake, Cimpean, 2011, pp. 141–150).

Depression is one of the most difficult to overcome diseases. Despite the large variety of anti-depressants on the market, the pharmaceutical efficacy of the treatment is achieved in only 25% of patients after the first stage of treatment (Friedman, 2013, p. D3). Clinical form of assistance to children and adolescents with major depressive disorder should not be limited exclusively to pharmacological treatment, but should also involve the ethical aspect of the problem. In this context, there is a need for appropriate psychological environment of life of the patient, who must be sufficiently aware that the aid did not produce the opposite effect, which has proven to be the cause of deepening of depression. Understanding

the living environment of a child and social context of illness can act as a clinical intervention that combines aspects of measures to improve the condition of the individual patient and social change in the context of the perception of depression. Such actions may result in getting information on the factors directly affecting the appearance of emotional problems, intolerance to himself and the world, and consequently the depression of a young man. Acquiring such knowledge can lead in fact to the orientation of path treatment and the gradual integration of the child in social structures (Furman, Bender, 2003, pp. 134–135).

Summary

Depression is a disease disrupting the normal functioning of the human being and his inner circle. The situation is particularly difficult when it affects school-age children. This results in irregularities in the proper physical and mental development, and prevents making contacts with peers, leading to a deepening of the social maladjustment and other, more serious, often tragic consequences. That is why it is so important that parents and teachers are able to recognize the symptoms of depression and know the etiology of the disease. Furman and Bender (2003, p. 124) report that a growing number of people is buying books concerning symptoms of depression, which may constitute evidence of an increase in public awareness of the nature of the problem.

Due to the fact that depression has highly visible, negative effects on the functioning of the child in the family, school and social, one should take action to help the patient to adapt to the environment, making a variety of social roles and the fight against pessimistic thoughts. However, the aid flowing from parents and teachers to be effective must be professional. Therefore, there is an urgent need to spread knowledge about the nature of depression as a disease entity. It is vital as the number of young persons struggling with this disease continues to increase. Spreading meaningful information on the treatment of depression may be helpful in alerting patients and the public that depression is a treatable disease, once you have the knowledge of how to fight it and of places where you can seek help.

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Functioning of a child with depression in the school environment

Abstract

According to the current classification of medical system, depression is an affective disorder, which symptoms manifest themselves through psychological, behavioral, and physical dysfunction. Among the causes of disease biological and social factors are mentioned. Depression in children and adolescents is not a new subject, but still there is no sufficient knowledge of the mechanisms that are responsible for its development, as well as the full range of symptoms, treatment and prevention of depression among children and adolescents. The problem of depression among young people is particularly important due to the presence in this period of high susceptibility to environmental influences, shaping social relations, as well as the acquisition of knowledge and skills necessary in later life. This can cause significant deterioration of family and social relationships, and the most troubling may cause suicide of the ill person. The problem may concern even 10–15% of children and adolescents, and the average age of onset for depression is 14 years of age and still decreasing (Heller, 2012). It is

crucial to correctly diagnose depression, and that despite the difficulties in its treatment it is a treatable disease (Swiecicki, 2002, p. 152).
The attempt to analyze the literature allowed the statement of the main facts about depression as a disease entity, and to highlight the increasingly frequent occurrence of depressive disorders in school-age children. The authors also pointed the way to deal with a pupil suffering from depression at school. An important recommendation was the need to popularize the various social groups of knowledge about depression, especially in the school environment where children and young people have regular contact, and which has a strong influence on their development, which can be very helpful in treating the disease.

Key words: depression, pupil, school environment, social problem

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POPULARIZATION OF KNOWLEDGE – NEW EDUCATIONAL AND SOCIAL IMPLICATIONS

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Paradigmatic crisis and biomedical research

Introduction

This article aims to question for the first time a contemporary scientific theory: intercellular communication which will be studied through experimental sciences, as well as human and social sciences.

Biomedical research as a whole possesses a common denominator: it is based on a physiological-chemical-physics conception of the living. Cellular and molecular physiology teaches us that our cells, fundamental bricks of the living, hold an intercellular communication with a chemical physics nature, based on a lock and key model. Several chemical messengers, such as hormones or neurotransmitters, are the support of a cellular information and signals.

The chemical-physics conception of the living first appeared in the 1900's after the cell theory was accepted by one of the neuroscience founders: Santiago Ramon Cajal, a clinical pathologist. He first put forward the existence of a chemical messenger between neurons and thus, an intercellular communication.

If one analyses every scientific publication on the international website "Pubmed", it appears that in 1923, a first set of data feebly suggested another form of intercellular communication. In the 70's, the scientific literature was increasing on that subject, mentioning another form of intercellular communication based on ultra-weak electromagnetic signals. From 1970 to 2015, several works have been led by different research teams from different countries, who put forward the same data. In 2009, Luc Montagnier, Nobel prize winner, published for the first time data on the emission of a genetic electromagnetic information coming from the DNA of a prokaryote.

Yet, the actual paradigm and the chemical physics conception established do not refer to any intercellular communication of an electromagnetic nature. It seems that the whole of these works, as well as those of professor Montagnier, are not integrated to the actual conception. Nonetheless, a paradigm was defined by Thomas Kuhn, a science philosopher, as the acceptance of a unifying theory within

a sociological system of faith in the scientific community. Can we thus speak of a crisis of the actual paradigm?

That is what will be tackled in this paper. First, we will put forward what really is a paradigmatic change according to the sciences philosophy. Then, we will present the establishment of the actual paradigm and the new experimental results which underline an unknown phenomenon and the theories that came along with it. The analysis of these data will allow us to determine whether or not a crisis of the actual paradigm is in progress.

Discontinuities and indicators of a scientific crisis

Scientific discontinuities

There are several scientific revolutions that can be named: rationality brought to the forefront by the pre-Socratic Greeks; the Copernican Revolution and the abandonment of geocentrism; Darwinism's introduction; relativism; the discovery of the DNA's structure; the Quantum's theory and the Special Relativity's theory.

Three authors disagree with the conception according to which science is continuously developing thanks to successive discoveries that do not call into question its founding principles.

Indeed, Bachelard, opposed to the point of view that science is continuously developed by slowly integrating new knowledge, showed that a new theory stems from an epistemological rupture: it is a radical innovation and cannot be issued from previous theories. The epistemological act that gives birth to a new theory is the synthesis of a theory rewrote and an epistemological rupture. To rewrite a theory, one first needs to mentally reorganise and then reorganise the knowledge that is to be explained in the new theory, which will be different than in the previous theory. The epistemological theory is the outcome of this rewriting. This rupture results from a constant desire to destroy existing theories in order to create better, more abstract and purer theories. It implies to look at the reality and find what contradicts the former knowledge, for the human spirit is lazy.

Furthermore, according to Popper, a scientific theory is a hypothesis which will be one day refuted and replaced by another one. It thus cannot be declared as true. This affirmation comes out of the fact that he categorically refused induction which cannot be logically justified. A hypothesis or theory is refutable if it is possible to imagine an observation wording that can contradict it. For Popper, refutability is the criterion that differentiates science from non-science. In the approach of the science evolution, Popper granted a lot of importance to refutation because: 1) as it is not possible to justify a theory's truth, the latter is thus merely a work hypothesis, an adapted construction to our observations for the moment; 2) It is almost sure, that this new theory will be refuted one day thanks to new observations which will end up with the elaboration of a new theory.

Finally, Kuhn explained that the evolution of science is due to the different revolutions which give weight to the attitudes and beliefs of the scientists themselves. In most of the fields, there is a sort of prehistory in the considered discipline: several rival schools of thoughts mingle with each other. The reason for this is that in the absence of a theoretical framework, it is impossible for all the researchers to rely on one and only conception about the kind of phenomena they are studying. According to Kuhn, a discipline is really considered as science when all the scientists possess the same conception on it and agree on the problematics or refute together the possible answers. This presumed knowledge constitutes the paradigm shared by scientists. Thus, the Newtonian Mechanics and Einstein's Special Relativity are examples of this paradigm.

Indicators of a scientific crisis

Besides, Kuhn developed a concise analyse on the existence of a scientific crisis and the indicators that allow to identify it in his publication "The structure of the scientific revolutions". According to him, the scientific revolution and crisis ensue from an anomaly. The latter occurs when an experimentation that tries to precise something else is led or when there is a disagreement with what the paradigm predicted. It takes the shape of an apparition of an unknown phenomenon to the paradigm. An accumulation of anomalies or one single anomaly that touches the paradigm's founding principles lead to a paradigm crisis: Scientists discover they cannot claim their knowledge presumption. As this crisis cannot last for long, a new paradigm takes place and gives an explanation to the anomaly detected before. Its adoption by the scientific community states of its new stage of "normal science".

Indeed, in Kuhn's opinion, the path from a theory to another is due to a causal mechanism of a sociologic and psychologic nature, not a critical examination.

From this extract of Kuhn's publication, the indicators that allow to identify a scientific crisis amongst a paradigm are the following:

Scientists behave differently towards existing paradigms when there is an anomaly or a crisis and their researches' nature change consequently. The proliferation of rival variations of the paradigm, the need to try anything, the expression of a clear dissatisfaction, the use of philosophy and discussions based on theoretical grounds are the signs and symptoms of the path from normal research to extraordinary research.

- Indicator 1: The proliferation of rival variations of the paradigm,
- Indicator 2: The expression of a clear dissatisfaction,
- Indicator 3: The need to try "anything",
- Indicator 4: The use of philosophy and discussions based on theoretical grounds.

These four main indicators will be used for our analysis throughout the rest of this publication.

Evolution of the scientific knowledge on the intercellular communication: from the actual paradigm to the new experimental discoveries

The actual paradigm

The cell theory (Texier-Vidal, 2011) was born thanks to the invention of the microscope at the end of the 17th century, however, its elaboration took more than a century. During this period, it benefitted from technical progress and the accumulation of microscopic images. This theory is the result of a remarkable effort of abstraction which led from the extreme diversity of images to the joint concept of a round cell that splits into two daughter cells etc. This abstract concept was not well received and gave rise to a persistent controversy and famous among Bichat's school, Auguste Comte's school and the Vitalists. One can notice that the scientists who have expressed this theory – to which their names are stuck to, such as Schleiden, Schwan and Virchow – have not all been discoverers of new morphological data. However, after several discussions, they were declared as the source of the best definition on cell, such as formulated by Schultz in 1861: "a small mass of protoplasm in which there is a nucleus". In that, it is at the origin of a new subject born in the middle of the 20th century: Cellular Biology. The Natural Sciences thus aim to study the mechanisms of chemical physics and physiologic that sustain life. This is the prolific attitude carried until now. Fifty years have gone by between the establishment of the cellular theory and the neuron doctrine, initially discovered by Cajal. The neuron doctrine (Texier-Vidal, 2011) can be considered as an answer to the general problem of the intercellular communication. The intercellular communication's existence and mechanisms were highlighted much later for most of the specialised cellular. However, the mechanisms involved were totally different as they possessed a humoral and paracrine nature rather than a morphologic nature. Yet, the cellular theory marks a significant step and has never been put into question since the scientists got used to it.

The first person who supposed that a chemical messenger intervened between neurons and thus that an intercellular communication existed was the clinical pathologist Santiago Ramon y Cajal in 1888 (Ramon y Cajal, 1906), one of the founding fathers of neurosciences. He observed there was a space between neurons. From there, he suggested that a chemical communication existed between neurons: this was proved a quarter of a century later. The physiologist Claude Bernard (Texier-Vidal, 2011) also studied the curare's mode of action in the second half of the 19th century. His pupil later showed that the curare stopped the communication between nerves and muscles. In 1914, another physiologist, Dale (Cheymol, 1975), noticed that a chemical substance named the acetylcholine produced similar actions to the heart (reduction of the heart beat), though the effects did not last long. He thus concluded that the Ach reproduced the parasympathetic nerves' action and that it should quickly be inactivated or destroyed. The works realised by Dale then by Loewi (Cheymol, 1975) in 1921 showed that the nervous transmission implied

the release of Ach in the pre-sympathetic nerve endings, and the interaction with receptors in the muscles' post synaptic membrane.

The works on neurotransmitters, the molecules released by the neurons in the synapses, stimulated another area of research. Indeed, if there is a chemical messenger coming from one side, there must be a receiver from the other side. In 1894, Emil Fisher first spoke about the lock and key theory which was then developed around the receiver by Dale in 1959. Nachmansohn then applied it to the Ach receivers (Cay-Rudiger, 2003).

As for the hormonal communication, it seems that the origin of endocrinology was discovered around 1849 thanks to the experiences of castration led on cockerels by Berthold who proved the endocrine role of the testicles (Klein, 1968). In 1889, the French neurologist Charles-Edouard Brown-Séquard initiated, without identifying it though, the first hormonal therapy (Klein, 1968). The discovery and the identification as such of the first hormone were linked to the observations made in 1895 by the renowned Russian physiologist Ivan Petrovitch Pavlov (Gerard, 2000). He suggested the existence of a secreting reflex initiated by the acidity of the chyme. To him, there was no doubt that this reflex was strictly nervous. However, in 1902, experiences led by William Mortlock Bayliss and Ernest Henry Starling, two British physiologists, showed on the contrary the existence of a substance secreted by the intestinal mucous and effective through blood on the pancreas (Bayliss, Starling, 1902). Bayliss and Starling named it "secretin". The term hormone was first introduced in 1905 by Starling.

The intercellular communication, as a scientific theory and paradigm in the 1900, is thus characterised through chemical physics mechanisms like the lock and key which involve chemical messengers such as neurotransmitters or hormones that have an impact on specialised receiver cells. The latter, once activated, allow the cell to enter a stream of transduction of the intercellular signal. This intercellular signs may, for example, induce activations or inhibitions of membrane proteins (such as canals) or of synthesis proteins and allow in any case the continuation of an initiated cellular communication.

New experimental discoveries

- *The proliferation of rival variations of the actual paradigm: Indicator 1*

More than 400 publications (Cifra et al., 2013) relate these new discoveries made since 1920. We will only present a few of them in this paper – the most representative.

From 1923, the embryologist Alexander Gurwitsh published in *Archiv für Entwicklungsmechanik der Organismen* and cast light for the first time on an ultra--weak emission of photons by living tissues that is called 'mitosic beam', which implies it has a stimulating effect on cell division.

In the 70's, Fritz-Albert Popp proved the existence of biophotons, coming from living tissues. Gurwitsh then suggested an operating theory which explained that

the biophotons could be involved in different functions of the cell, such as mitosis and that they even could be produced and detected by the cell's nucleus DNA.

In 1980 and 1981, Kaznacheev published in *Bulletin of Experimental Biology and Medicine* and *Nauka*, and highlighted the detection of a eukaryote intercellular communication created thanks to biophotons radiations.

Experimental results carried on and in 1984, Fritz-Albert Popp published in *Cell Biochemistry and Biophysics* and brought to light DNA as an important source of emission of photons because DNA's conformational change via ethidium bromide in vivo clearly showed changes in photonic emissions by cells. He thought that DNA was assimilated to an excimer laser. DNA is thus, like a laser, a "source" and "storage area" of photons. He pursued his studies and published it in 1992 in *Experientia* and explained that the photonic emissions by cells are a non-linear answer regarding external disturbances (he noticed chaos, fractal behaviour and non-equilibrium phase change). In 1997, he showed, thanks to his publication in *Science in China Series C Life Sciences*, that intact chicken's brains produce a higher level of photons intensity than damaged brains or that this level of intensity varies according to its development stage or freshness of the isolated brains. He suggested that the biophotons emission by living cells was due to the interaction between internal and external fields right next to the tissue.

These works were carried on and published in 2003 in *Indian Journal of Experimental Biology* and dealt with the human body.

The data showed that the photons emissions varied depending on the person's health and enabled to detect the regulating functions of the body: he suggested it as a new non-invasive tool for medical diagnosis.

In the meantime, in 2003, Beloussov and his co-workers published in *Russian Journal of Developmental Biology* and in *Indian Journal of Experimental Biology* as well. They presented their works which, thanks to a study on embryos and fish eggs, highlighted that the photonic beam produced by the embryos is actually a carrier of genetic information received and incorporated by the receiver egg without any chemical modification of the genome.

Moreover, in 2008, Chang also published in *Indian Journal of Experimental Biology* and carried out a study on the physical properties of the biophotons and their biological functions on fish. His data were in accordance with Popp or Gurwitsh's former propositions and he stated that the biophotons could indeed play a key role in the DNA's functioning, including the DNA replication process, the proteins synthesis, the cellular signs, the oxidative phosphorylation and photosynthesis.

In 2009, Luc Montagnier (Nobel Prize Winner of Physiology or Medicine in 2008) published in *Interdisciplinary Sciences*. He revealed for the first time that a bacterial prokaryote's DNA produces a small electromagnetic signal and, above all, that this signal carries out the sequential genetic information of the DNA. Indeed, a bacterial DNA is 98% identical to the initial DNA reproduced by PCR solely with the presence of the electromagnetic signal carried out by the initial DNA, elementary bricks and the polymerase Taq without any template strand DNA.

These data could be similar to former experiences but brought an additional fact: the DNA molecule really carries out an electromagnetic signal as suggested by Popp and Gurwitsh but this electromagnetic signal also conveys an information: the sequential genetic information.

Since these experimental results, other research teams have led and reiterated Kaznacheev's controversial experience of 1981 – such as Felds who published in 2009 in *Plos One* – and confirmed his results by using eukaryote cells.

In 2011, Rossi and his co-workers published in *Seminars in Cancer Biology* and repeated once more Kaznacheev's 1981 experience on eukaryote cancerous cells and showed that they deliver cancerisation information at distance to non-immortal cells while electromagnetic radiations are transmitted between two cellular cultures.

- *The expression of a clear dissatisfaction/controversy: Indicator 2*

Skepticisms came along from 1923 as Gurwitsh's results were not immediately reproducible. The explanation given by his detractors was that there was a rare process of oxidation on radicals.

Kaznacheev's controversial results in 1980–1981 were declared as artefacts. Indeed, owing to the difficulties encountered to isolate the biophotons' effects among the molecules numerous interactions, it is not possible to establish a verifiable theory. Furthermore, another objection is put forward: most of the organisms are immersed in light which intensity interferes with the biophotons' ultra-weak emission. This is why any communication is impossible.

This is the reason why the scientific community is constantly cautious towards all these experimental results that do not seem to be believable as they are not entirely explained nor based on a genuine theory, and are in disagreement with the actual scientific theories.

Montagnier's experience in 2009 did not reach out the French scientific community and the institutional authorities do not wish to finance the Nobel Prize Winner's researches for now. As a result, he moved to China to create his multidisciplinary laboratory there and pursue his researches abroad.

However, the controversies seem to continue but differently. For instance, Cifra's team and co-workers published in 2011 in *Progress in Biophysics and Mollecular Biology* and in 2013 in *Cell Communication and Signaling* an abstract on this possible new form of intercellular communication, the accumulation of scientific data in this area, and questioned this new way of signals. They concluded that, in theory, cellular signals via electromagnetic waves are possible, but they are limited either by specific biological events, or they require physical mechanisms that cannot be applied to biology for now, or these mechanisms are still unknown.

In 2014, Prasad and his collaborators published in *Journal of Photochemistry and Photobiology Series B* about the new perspectives in cellular communication and the possible role of a feeble emission of photons.

- *The need to try "anything": Indicator 3*

All the experiences led in order to highlight this anomaly have been orientated in different directions; the most original of all is given by the works of the Nobel Prize Winner Montagnier.

Indeed, Fritz-Albert Popp revealed the existence of biophotons issued from living tissues by using **photomultiplier tubes** that allowed him to detect these biophotons.

Then, the use of a **chemical agent**, ethidium bromide in vivo, showed a change in the photonic emission by the cells because of a conformational change of DNA by the ethidium bromide.

Studies on the human body were led by Popp and the experiences realised were executed in the dark thanks to a **photon sensor** on more than 200 people. This suggested it was possible to use a non-invasive tool.

Batches of eukaryote cells (such as cancerous ones) were studied in **culture dish** and put forward the exchange of information on remote cancerisation of non-immortal cells while electromagnetic radiations are transmitted between two cellular cultures.

Finally, the duplication of a bacterial DNA 98% identical to the initial DNA is reproduced thanks to a polymerase method of chain reaction called PCR, solely with the presence of the electromagnetic signal carried out by the initial DNA, elementary bricks and the polymerase Taq without any template strand DNA.

- *The use of philosophy and discussions based on theoretical grounds: Indicator 4*

Some works have been written since Gurwitsh in 1923 to give theoretical explanations to the results observed. A historical background of his works has been gathered later on in 1988 in *Experientia*.

In the 1970/1980's, Popp continued to write theoretical propositions based on a unique interpretation: DNA produces and receives electromagnetic waves that are bearing genetic information.

Yet, one of the first detailed and complete theories on that topic dates back to 1981 and was proposed by Emile Pinel, a medical physicist, who is at the origin of white cell biometrics. It seemed interesting to quote him as Pinel, even though he was criticised, suggested in 1981 that a cell's nucleus is a computer that possesses an electromagnetic transmission field thanks to energetic levels that it updates directly in line with the DNA: 28 years before Montagnier proved there was an emission of electromagnetic information from DNA in 2009, which was simultaneous to Popp's new experimental discoveries.

Emile Pinel, physical medicine doctor, was one of the first to attempt to model a living cell's functioning in 1981 in "Physique de la cellule vivante"; his suggestions did not scientifically prove the biological phenomena observed. He presented his theory to the French Academy of Sciences and to the rest of the scientific community

who were fearful to this theory, that was not experimentally explored and well criticised.

In his essay, he tried to link classic concepts of electromagnetism (area covered in Physics) to the living cell and cell nucleus (covered in Biology). He suggested the presence of an "H field", present inside the cell's nucleus. According to Pinel, this "intranuclear field" is created by a "magneto-biology law of vital induction" which is present in every living thing. To him, "this law creates a field that, as a result of its actions, has a role of magnetic field; it is similar to Lenz law in induction Physics". He clarified that "the H field has, as a result of its actions, a role of magnetic field which can thus be associated to the magnetic field studied in Physics", "H is located in the cytoplasm in which the nucleus is, not as a transmitter field like H, but as a receiver field that executes the orders of the nucleus cell".

In this way, this field could give a line of explanations as for the fact that the cell can both produce and receive information, apparently electromagnetic according to Pinel.

Since 2009 and Montagnier's experiences, discussions on theoretical grounds keep increasing and always go in the same direction, such as Cifra and Prasad (in 2011 and 2014 respectively).

Discussion and conclusions

All of the experimental research works realised between 1923 and 2015 dealt with a new non chemical-physics intercellular communication that highlight time an intercellular communication based on a genetic electromagnetic information.

Every author mentioned in this paper, coming from different research teams and different countries, highlighted either a cancerous cellular culture, or a living tissue at different stages, for example that respectively caused cancer or acceleration in the development of the control groups, and this without any chemical-physics communication, but with an electromagnetic information.

It appears that after Luc Montagnier's experimental results in 2009, no actual link was made in the scientific literature between his data and an intercellular communication based on electromagnetic information. Indeed, his experimental results did not directly question this type of signals. Nevertheless, it seems that all the data were already present in the scientific literature.

In the end, we do not know whether Pinel proposed his theory after the first experiences were realised in Germany in 1923 by Gurwitsh and in 1970 by Popp. Nonetheless, at this time, these experiences could only suggest the reality of an electromagnetic waves transmitter field. Nowadays, the Nobel Prize Winner Luc Montagnier's experimental results in 2009 brought new data which prove the existence of such a communication field produced by DNA.

Finally, we can see in the light of these data a totally new phenomenon to the actual paradigm which appeared in 1923 up until now and was controversial,

illustrated by an accumulation of anomalies that affected the founding principles of the actual paradigm.

Besides, this analysis allowed us to highlight and list four precise indicators. In fact, it appears that: from the proliferation of rival variations of the actual paradigm, from the expressed dissatisfaction, from the numerous methodological approaches tested, and from the multiple discussions on the founding principles of the actual paradigm; all the following criteria are the features proving the existence of a scientific crisis.

But, as previously seen, the philosophers in science agree that the conception, according to which science is continuously developed thanks to successive discoveries that do not question its founding principles, is a heresy. It is obvious for them, as Bachelard illustrated with the "epistemological obstacle", that science is developed thanks to discontinuities: we call this a change of paradigm.

Even though Fuller (Fuller, 2006) underlined, that the general model of Kuhn's scientific revolutions was elaborated from several historical facts in Physical Science dating back to many centuries ago, and in a perspective that Pestre (Pestre, 2006) named the judged history. This form of history stipulates that today's scientific results allow to judge previous propositions and, as he said, "to distinguish, as the scientific before used to say, what falls under the order of the world's truth and what is the order of the prejudices and social" (p. 32) and this, even if you support the thesis on the incommensurability of the successive paradigms.

Incidentally, Kuhn determined that a paradigm crisis and the beginning of a scientific revolution result from an anomaly that occurred during an experience, which aim was to precise something else or a disagreement with the paradigm. According to the epistemological theories, the accumulation of anomalies led to a paradigm crisis. This crisis is set but cannot continue and that is why a new paradigm is created in order to explain the anomaly found in the previous paradigm. Thanks to its adoption by the scientific community, it reaches a new step of "normal sciences". Callon and Latour (Callon & Latour, 1991) noted that Kuhn's works allowed to make the social and intellectual explanations and the production of knowledge compatible. According to its authors, he succeeded thanks to his use of the paradigm's concept:

> The blurred magic of the word "paradigm" fits in this double meaning: it indicates a certain way to understand and perceive the world, arbitrary, coherent and irreducible to any other [...], but is also a social organisation with rules, solidarity, learning, a proper identity. Why were the social and cognitive separated for so long? The two of them are inseparable and the group would not be able to define themselves outside of these conceptions of the world that its members share and which structure the knowledge it produces; In return, without the mechanisms of social integration, learning, transmission of a cultural matrix, it would disappear and would not have any consistence. With this solution, everything is inextricably socio-cognitive: the arguments, the proofs, the research problems cannot be separated from the social game they are involved in. (p. 18).

However, this analysis led us to think about the distinction between a rival theory and a change of paradigm. Indeed, are all of the identified clues in this study really representative of a possible paradigmatic crisis in progress, or is it only the reflection of a rival theory emerging?

For Kuhn, it seems that every perception is linked to an intention. According to this author, every measure, every fact is bound to a paradigm, which explains why once a new paradigm is in competition with a previous one, the discussion is not only based on the disproof and facts, but also on the belief in a paradigm. Most of the former paradigm's disciples do not change their mind, no matter the experimental 'proofs' brought, because they are meant to be read only with the new paradigm; they are not understandable with the former paradigm.

That is actually what differentiates Popper and Kuhn. Popper thinks that the theories are no representations and that it is impossible for the scientific discoveries to come down to a psychologic disruption. So as to have a logical scientific discovery and a rational evolution of the scientific knowledge, science must not compete with mental constructions, representations determined by *causes*, but will with symbolic constructions, theories loose from a thinking subject, likely to logically select on *reasons*. However, he thinks that a scientific theory comes along with a certain representation of the world which can psychologically affect our subjective relation to reality. In this, he partially agrees with Kuhn who suggested that the passage from a theory to another comes under a sociological and psychological causal mechanism, and not from a critical exam. He thus defined a paradigm as the acceptation of a unifying theory among a sociological system of beliefs in the scientific community.

It finally appears that the awareness and the manifestations of the sociological and psychological dimensions of the scientific anomaly studied through different indicators allow us to question a paradigmatic change and not only on the confrontation of two rival theories. Indeed, the emergence of this anomaly led us to question once again the unifying theory of the actual paradigm.

Can we thus talk about a scientific crisis?

If such a paradigmatic crisis is in progress, it would allow us to suggest a new vision initiating a scientific revolution: a complementary intercellular communication, both chemical-physics and electromagnetic.

Yet, all of the biomedical researches are based on the lock and key conception and a chemical-physics communication. A new vision would revolutionise the biomedical research's approach.

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Paradigmatic crisis and biomedical research

Abstract

The actual paradigm and the chemical physics conception established do not refer to any intercellular communication of an electromagnetic nature. But the scientific literature from 1970 to 2016 mentions another form of intercellular communication based on ultra-weak electromagnetic signals. Several works have been led by different research teams from different countries, who put forward the same data.

Nonetheless, a paradigm was defined by Thomas Kuhn as the acceptance of a unifying theory within a sociological system of faith in the scientific community. Can we thus speak of a crisis of the actual paradigm?

We can see in the light of these data a totally new phenomenon to the actual paradigm which appeared in 1923 up until now and was controversial, illustrated by an accumulation of anomalies that affected the founding principles of the actual paradigm. This analysis allowed us to highlight and list four precise indicators. In fact, it appears that; from the proliferation of rival variations of the actual paradigm, from the expressed dissatisfaction, from the numerous methodological approaches tested and from the multiple discussions on the founding principles of the actual paradigm; all the following criteria are the features proving the existence of a scientific crisis.

The emergence of this anomaly led us to question once again the unifying theory of the actual paradigm. If such a paradigmatic crisis is in progress, it would allow us to suggest a new vision initiating a scientific revolution: a complementary intercellular communication, both chemical-physics and electromagnetic.

Key words: paradigmatic crisis, biomedical research, scientific revolution, scientific community

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Addictive effects of alcohol

Alcohol – a bit of history

In the common understanding, that is the awareness of an average person, alcohol is identified primarily as a consumable product. Such thinking dates back to as early as prehistoric and ancient times, when the first alcoholic beverages were created by chance and coincidence. This happened during the improper storage of ripe fruit, mostly grapes, which led to unintended alcoholic fermentation, which resulted – undoubtedly to the surprise of the primitive man – in the natural transformation of fruit into wine, and of improperly stored fermenting barley grains into beer (Maciejczyk, 2012). As is mentioned in the Bible, the most common crops grown at that time in the Middle East, along the Nile, were wheat and barley. Wheat was considered to be a basic food, but also a measure of wealth of those who grew and traded it. Barley was the crop of the poorer classes. Nevertheless, both wheat and barley were very often consumed in the natural, raw form, milled into flour and groats (Abdali, 2001). After the exodus from Egypt, the settlers in Canaan "actively planted vineyards and gardens". Grapevine was commonly grown practically throughout the whole period covered by the Old Testament, planted in valleys and rough plateaus alike. It was a particularly favored plant and wine was drunk in large amounts, not only during feasts but in everyday life as well, also in sanctuaries, as it symbolized the mystery of living "with God and in God" (Fouquet, de Borde, 1990). Red wine was given preference, for although it was not known for certain, it was assumed to have antioxidative properties, as it contained resveratrol – a phenol with strong antioxidant activity. Grapes were used for the production of not only wine, but also preserves, juice, honey, grape vinegar and raisins. Both food and wine were considered by the Hebrews to be a gift from God. All kinds of alcoholic beverages were treated with respect and reverence by the Egyptians.

Since the beginning of mankind, the history of alcoholic beverages is closely connected with the religion and history of nations. Wine and other alcohols – prevalent and ubiquitous elements of whole nations – were capable of bringing the

joy of life and providing relief from suffering. It was believed that the inebriating power of alcohol evoked the transcendental feeling of immortality. At the same time, it was acknowledged that it must be treated with a high degree of caution, as it could be a source of not only joy, but also suffering and wrong (Gabriel, Geaves, 2007). Indeed, the Old Testament reveals that people were warned against drunkenness and forbidden to drink immoderately, as it was against God's will (Wojciechowski, 2009). The issue of alcohol has been addressed by numerous papers in the fields of biology and medicine, also in the context of the mental, somatic and neurological consequences of alcohol abuse, as well as the social implications following the manifestation of alcoholism.

Alcoholism as a disease?

Alcoholism, alcoholic disease or alcoholic toxicomania – these concepts refer to the kind of disorder which consists in the loss of control over the amount of alcohol consumed. The loss of control results from a compulsion of mental and somatic nature, and is independent of a person's will. The development of the mechanism of the addiction has still not been fully determined, and is not directly connected with alcohol abuse, although it eventually leads to such a result.

Research studies show that the mechanisms of action of ethanol and morphine seem to be closely comparable. The chronic use of alcohol increases its consequent consumption, similarly to the use of small doses of morphine which, over time, evolves into the need to increase them (Reid, Hunter, 1984). Studies on alcohol dependence show that alcohol often causes irreversible changes to the structure and functions of the central nervous system (CNS), including in terms of memory disturbances and the ability to make associations and think in the abstract way. Changes in CNS caused by alcohol abuse result in impairment of the secretion of neurotransmitters, changes in the properties of receptor membranes and the activity of many membrane enzymes. The said changes develop, and even intensify, as the period of excessive alcohol consumption lengthens, and thus intensify the ensuing need to drink it in increasingly greater amounts.

Is alcoholism a disease? The problem was repeatedly addressed by Elvin Jellinek (1942; 1960; 1993), who described alcohol dependence as nothing other than disease. His proposition attracted supporters from among not only doctors and therapists, but also the persons concerned, that is alcoholics. According to Jellinek, the loss of control over drinking is a result of pathological biological processes induced by the toxin, i.e. alcohol, and not a person's bad character or lack of strong will. This led to the creation of a *disease-based* model of addiction, broader than merely a *moral* problem. Since alcoholism is a disease, it can be cured. It is enough to administer an adequate therapy and – most importantly – stop drinking.

Lewis (1991) believes that alcoholism can be compared to other diseases, such as diabetes or schizophrenia. Many researchers share the opinion while emphasizing that alcoholism is of a very complex nature, is chronic and often incurable, and can

even lead to death. Accepting the thesis that alcoholism is an incurable disease would be tantamount to setting bounds to the possibilities for its treatment, hinder the successful therapy and individual rehabilitation of alcoholics, and generally prevents solving various alcohol-related problems. While a conventional (normal) disorder can be managed with an adequate therapy, curing an alcoholic from alcoholism without their consent is impossible. Treatment imposed *by force* and against the will of a patient will not be efficient. Administering therapeutic and pharmacological agents will not fulfil its remedial role unless the patient is willing to limit or quit drinking altogether, and attempt to fight the addiction (Tesson et al., 2005). Effective results can be achieved mainly by means of psychological therapy. For that reason, many researchers assume that the problem of alcoholism should be analyzed primarily in the context of behavioral processes related to alcohol consumption.

Such reasoning might lead to the conclusion that if a given functional state of the organism is a disease, pathological factors and pathological changes should manifest themselves in the formerly healthy organism – changes leading to the loss of the broadly defined functional efficiency of the organism. If alcohol dependence is a disease, then the pathological factor should be identified as nothing else but ethyl alcohol, which is considered to be a poison, particularly when consumed frequently and in large amounts. As a poison, alcohol induces noticeable and *medical* changes in the organism, such as impaired control over alcohol use, distinctive behavior after its consumption, or the intensifying need to drink it. What is also significant is the biological (morphological) degradation of organs and tissues developing at a rate of months to years, a higher degree of tolerance to increased amount and frequency of alcohol consumption, or the deterioration of mental health through chronic intoxication. Such data indeed suggest that alcoholism can be considered a disease (Mazur, Małkowska-Szkutnik, 2010; Tesson et al., 2005).

However, if alcoholism is not a disease, then what kind of phenomenon is it? Many people drink alcohol, yet they are not ill, they behave reasonably, do not fall into addiction. After all, not everyone who frequently abuses alcohol should be regarded as an alcoholic or addict. Such *normal* drinking patterns are found in every culture and religion (except Islam), and every continent. There is, however, one condition that must be fulfilled – the drinking should fall within the bounds of the so-called *moderate alcohol consumption*. There are those who believe that this level of alcohol consumption can even bring positive outcomes, e.g. it can contribute to life extension, that is longevity (Brodsky, Peele, 1999).

It is thus evident that alcoholism constitutes a problem when alcohol consumption is more than moderate. It then becomes not only risky and harmful to health, but also detrimental to the mental and social functioning of an alcoholic. For this reason, some researchers in the field propose that alcoholism be treated as a set of behavioral disorders generating the so-called addictive behaviors which increase the risk for not only disease, but also serious personal and social

complications. Such behaviors might manifest themselves in, among other things, the loss of control over drinking (Maisto et al., 2003; Marlatt, Witkiewicz, 2002). Many experts acknowledge alcoholism to be a serious medical problem, the solving of which should be approached through medical means (Lindenmeyer, 2007).

What do we know about alcoholism?

Attempts at explaining the mechanisms behind alcoholism have been and still are made by many experts in the field. From the sociological perspective, alcoholism is considered a social phenomenon which manifests itself in social maladjustment and is thus highly undesirable. It is known that alcoholism is a problem faced by not only an individual, but the whole community where the person lives, particularly their family and co-workers.

Alcoholism causes considerable moral and economic damage and generates losses at every level of the coexistence of an alcoholic with other members of the society. The social costs incurred by alcoholics are very high. Moreover, the estimated life expectancy of a habitual alcoholic is approximated at 10–12 years shorter than the mean life expectancy of non-drinkers. It has been determined that mortality among alcoholics is over twice as high as that of non-addicts. Alcohol is one of the major causes of traffic accidents and a contributor to their increased risk. It is estimated that nearly 50% of household accidents and 65% of all instances of drowning are a result of alcohol abuse. It turns out that nearly 80% of suicides are triggered by alcoholism or its short-term influence. Alarming criminal data indicate that chronic alcohol consumption constitutes a factor stimulating homicide, misconduct and physical violence. Approximately 20% of hospitalized alcohol abusers are a source of trouble to the healthcare staff, irrespective of the type of diagnosis. The social costs of the phenomenon of alcoholism and the expenses related to the strategies for its prevention amount to 20% of the total healthcare expenditures (Dymek-Balcerek, 2000; Fudała, 2007).

While the physiological interpretation of alcoholism rests on the analysis of the biochemical and health damage that it causes to the organism of the abuser, the consequences of drinking also translate into implications for his social environment. Analysis of different routes to addiction draws attention to the relationship between psychological dependence, the physiological homeostasis in the living organism of an alcohol abuser, and the person's external social environment (Griffith, 2001; Herzberger, 2002).

Attempts at defining alcoholism

There exist various definitions of alcoholism. Some of them are merely of a descriptive character, and some are more detailed. Some focus on the effects and consequences of alcohol abuse, while others on its symptoms or the frequency of excessive consumption. Some organizations, such as the American Psychiatric

Association, an international federation of psychiatrists, believe that alcohol abuse and alcohol addiction can be considered separately. Alcohol abuse can be interpreted as the level of drinking which leads to the impairment of and even threat to health, while addiction involves psychological dependence which eventually leads to physical dependence.

It was only over 60 years ago that Elvin Morton Jellinek (1890–1963), an American biostatistician and physiologist of Czech descent, became a pioneer in the study of alcoholism as a phenomenon and the author of the original typology of alcoholism. He sought to prove that alcohol addicts should not be the target of contempt; instead, they should be treated as persons who need help and should receive treatment. Jellinek was appointed an expert at the World Health Organization (WHO) and spent much of his time working in the USA, Hungary, as well as South American countries. In 1956, thanks to his inspiration, the American Medical Association decided to recognize alcoholism as a disease, and not merely a set of specific moral disorders. Five years earlier, in 1951, WHO accepted the postulate that alcoholism was a medical problem and made an attempt at its classification (Pospiszyl, 2008; Woronowicz, 2009). In 1960, Jellinek published his influential book entitled "The disease concept of alcoholism". Consideration should also be given to the thesis advanced by Jellinek whereby alcoholism bore the characteristics of a disease as the loss of control over alcohol consumption triggered the progression of pathological symptoms and consequently lead to premature death. In 1969, Jellinek presented a fairly comprehensive theoretical model of alcoholism which assumed that an alcoholic was unable to control the level and frequency of alcohol consumption.

Apart from Jellinek (Jellinek, 1942), the opinion that alcoholism should be considered a disease was also shared by many other researchers in the field, such as Edwards and Gross (1976), Habrat (2013), Horvath and Kekesi (2006), Pospiszyl (2008), Vaillant (1983), or Wallace (1989). Other models of alcoholism were subsequently created, e.g. the compensation or the psychosocial model (Brickman et al., 1982; Marlatt, 1992).

In 1976, the American Council on Alcoholism accepted the definition of alcoholism as a chronic, potentially life-threatening disorder manifested by an increased tolerance to alcohol consumption, physical dependence and pathological changes in several organs (Jelski et al., 2007; Joshi, Guidot, 2007; Orywal et al., 2009).

Alcohol dependence and tolerance

The International Statistical Classification of Diseases and Related Health Problems (ICD) has introduced ten versions of the definition of alcoholism, the last of which leaves off the term "alcohol-related problems". Instead, it refers to the harmful effects of alcohol intake while avoiding or somewhat disregarding the problem of addiction. It is assumed that there are more non-addicts who drink "normal" amounts of alcohol than addicts and the difference between them can

amount to as much as 30%. On the basis of results obtained from numerous sources, Woronowicz (2009) reports that in modern Europe, that is at the turn of the 21st century, approximately 5% men and 1% women are alcohol dependent.

An interesting though somewhat surprisingly naïve stance was adopted in 1969 by WHO, which suggested that alcohol dependence was a specific mental and physical state. According to Woronowicz (2009), it is a state "resulting from the interaction between the living organism and alcohol". The said "state" leads to changes and consequences to the behavior of the abuser which force him to make every effort when circumstances are conducive to alcohol consumption, or – if they are not – to seek to obtain alcohol for ad hoc drinking wherever possible, so as to experience pleasure derived from the act and relieve the growing mental discomfort as quickly as possible. The processes involved in alcohol dependence are also dependent on the volume, and – most importantly – frequency of intake of doses of this addictive substance, framing the concept of the so-called tolerance.

In physiology, tolerance is defined as a specific functional state in which gradually stronger stimuli are required in order for a given reaction to be triggered. In the context of alcohol this means that in order to achieve the desired effect of its consumption, the drinker is forced to gradually increase its dosage, or that the effect gradually becomes weaker when the doses are kept at a constant level. In other words, a person addicted to alcohol must drink more and more in order to achieve the same effects of consumption.

It seems that the task of defining alcohol dependence presents a challenge already in terms of the initial stage of its diagnosis. Its analysis ought to be based on numerous aspects – the amount of consumed alcohol, the frequency of consumption, the physical and mental response after drinking, inducing changes in behavior and attitude toward the immediate environment, as well as the prevalence and severity of biological changes incurred. These add up to a set of somatic and psychological symptoms which have a bearing on the social relations of the alcoholic.

The aforementioned psychological and physical dependence should be taken into consideration when analyzing the concept of addiction. The first type "orders" to continue drinking, so as to give oneself the opportunity to experience feelings or sensations that accompanied the previous acts of drinking and that were or seemed to be pleasant. The second, physical type of dependence, is something of an adaptation to alcohol consumption driven by purely biological needs, that is those governing the normal, everyday functioning of the organism of the abuser. Therefore, stopping the consumption of alcohol might lead to the so-called withdrawal, or abstinence, syndrome (Kumański, Pisarski, 2010).

Due to the aforesaid difficulties in classifying addiction-related problems, internationally recognized and adopted projects have been created which cover the fundamental methodological assumptions and also provide adequate practical solutions. These are the Diagnostic and Statistical Manual of Mental Disorders

(DSM-IV) and the International Statistical Classification of Diseases and Related Health Problems (ICD-10).

DSM is based on a classification developed by the American Psychiatric Association and was introduced in 1994. ICD-10 is the tenth version of the International Classification of Diseases and was introduced by WHO in 1992. In Poland, ICD-10 has been complied with since 1997, that is for nearly 20 years. Both proposals for the classification of alcohol dependence stress the significance of individual traits and individual circumstances surrounding the development of addiction and affecting its severity.

As has already been mentioned, alcohol consumption, even in relatively small amounts, is harmful to a person's health and affects the shaping and development of their personality, as well as their social development. It also alters the previously normal behavioral patterns of the individual which in turn generate new ways to satisfy his needs. For this reason, the consequences of alcohol consumption are of interest to the field of not only medicine, but also social sciences. For instance, pedagogy focuses on analyzing the "acceptable values fostered particularly by the young generation". The said acceptable values stimulate the motivation to act, whereas values which are externally "imposed" by, for example, parents or teachers, only reinforce that motivation in a drinking individual. Issues related to systems of values have been reflected in theoretical and empirical considerations of researchers from many scientific fields. Most scientists share the belief that the shaping of a person's value system is of significance to the process of education of not only young people, but also the society as a whole (Lipiński, 1996; Tobiasz-Adamczyk, 2000).

In common opinion, one of the values of the highest significance is health. It is a universal, timeless and fundamental value common to the whole *Homo sapiens* species and independent of the various social norms, customs, trends, ideologies and political systems which have been and are being introduced. Health is a value which allows every member of the *Homo sapiens* species to establish and pursue their own goals, both individually and within a social group. In the light of this fact, it seems that health should be given special attention, not only provisionally, but also educationally, that is already at the initial stages of education of children, whose understanding of the hierarchy of values – particularly with respect to health – should be developed relatively early (Jankowski et al., 2013; Leonard, Blane, 2003; Maisto et al., 2003). It can be agreed that those individuals who are more concerned about their health tend to treat it with more respect and generally display more health-oriented behaviors while avoiding potential health risk factors, such as the abuse of nicotine, alcohol or drugs (Mellibruda, 2001).

It is known that the basis for the cooperative functioning of individuals is their ability to communicate with one another. This communication is necessary to build a close rapport within the family, which is especially critical when it comes to alcoholic families. The first symptom of disorders affecting interpersonal

communication within a family is impaired social development of a child growing up within that family. A parent's alcoholism exerts a significantly negative effect on the child's psychological, mental and physical development. It contributes to mental deviations as it eliminates the normal, healthy connections and emotional relationships. The child is deprived of the sense of personal safety, as well as moral and spiritual support, and follows abnormal patterns of behavior.

A report prepared by the Confederation of Family Organizations in the European Union (COFACE) revealed that approximately 42 million of European Union citizens, both men (14%) and women (4%), admitted to alcohol abuse or alcoholism. Provided that an average drinker lives in any kind of relationship with another person, including non-drinkers, it might be assumed that about 84–85 millions of Eastern Europe citizens remain somehow linked to the problem of alcohol abuse. If we add other family members, that is children, it will amount to about 4–5 millions of young – very young – citizens suffering from the problem of alcohol dependence.

The costs of losses sustained due to any of the abovementioned reasons are difficult to be reliably estimated, especially at a national level. The rate and scope of their development vary as the alcoholic disease progresses in an individual. The process initially seems to be virtually unnoticeable and can be reversible up to a certain point, and the criteria for estimating the related losses are not always exact and explicit. Many people decide to stay with their partners despite their progressing alcoholic disease for reasons connected with accommodation, children, financial input of the alcoholic into the shared household budget, or simply out of fear.

Is it possible to drink safely?

It must be conceded that it is impossible to determine the limit to safe drinking, as it is practically unmeasurable. In differing circumstances, a person might respond differently to the same amounts of alcohol consumed or respond similarly to different amounts consumed. These relations appear to be highly variable and depend on many factors, such as the physical condition, nutritional status, satiety status, mental state, fatigue, or motivation of the drinker, or the quality of alcohol consumed. The inability to determine safe drinking limits results in the loss of control over the amount of alcohol consumed, which can, in its mild form, lead to a harmless alcohol intoxication, but when taken to extremes – result in complete dependence with all its consequences, including death (Pospiszyl, 2008; Szabo, Mandrekar, 2009). Most researchers unanimously agree that the phenomenon of alcohol dependence is a complicated, complex and multifaceted process, affected by various determinants within different domains of health. Keller (1993) explains that addiction as a phenomenon and a process is attributable to human beings and not to the lifeless substance called alcohol, and that physical dependence does not exist without mental dependence. If, however, the said assumptions preclude alcoholism from being considered a disease, then all agree that it might lead to a disease, or even a number of diseases (Kamińska, Kumański, 2012).

What is important is when and how alcoholics start to drink, how they learn to drink and how they organize their drinking until they cross the threshold of addiction. Over time, negative behaviors become reinforced and lead to the loss of control, increased tolerance and, consequently, pathological drinking (Gilpin, Koob, 2008). This points to the reasonable conclusion that a drinker develops addiction through developing behavioral patterns when drinking, observing the consumption of alcohol by others, and strengthening one's motivation to drink and response to alcohol consumed. Drinking behaviors are significantly affected by a person's psychological background, particularly stress, negative emotional states, depression, or helplessness against the consequences of drinking (Rosenberg, 2007). When diagnosing alcoholism, consideration should be given to many symptoms, both those that are somewhat interrelated, and those that are recurrent.

WHO defines alcoholism as "any form of drinking which exceeds the traditional and customary consumption of alcohol and departs from social norms of drinking accepted by the community, regardless of the etiological factors behind such behaviors and of the degree to which those etiological factors are determined by the genetic and physiological capabilities of an individual" (The World Health Report, 2004). While many publications interpret alcoholism as mental dependence, i.e. a process remaining outside the control of a drinker, medical literature acknowledges that there exist physiological differences which are linked to genetic elements, that is hereditary factors governing the susceptibility to psychoactive substances, between people who drink compulsively because of addiction, and those who follow healthy (normal) patterns in this respect, in that they consume alcohol at low to moderate levels (Baumeister et al., 2000).

Alcohol – what next?

The neurophysiological areas of alcohol dependence have still not been explored and described thoroughly enough so that a comprehensive and efficient treatment regimen could be developed. It is known that prolonged consumption of alcohol by addicts is directly connected not only with somatic and physical needs but, above all, with the psychological imperative consisting in the loss of control over the consumption. An addicted person displays marked behavioral changes which concentrate his actions on seeking and obtaining alcohol. According to the World Health Organization and the American Psychiatric Association, the said changes constitute main symptoms of mental, and not necessarily physical, dependence. In this context, administering an alcohol addiction therapy based on detoxification is insufficient, as it does not ensure an end to addiction. An alcohol addiction therapy should allow for the need for a cause-targeted intervention, which would provide an insight into neurophysiological processes and phenomena determining dependence syndromes. Another issue essential for such a therapy is knowledge about negative emotional states experienced by an addicted person, about conditioned response to repeated negative stimuli, such as the smell of alcohol or the sight of people drinking

it, as well as about stressful situations related to professional and personal life. All those situations might trigger a relapse of heavy, uncontrolled drinking after a period of abstinence. Researchers studying this issue have been investigating possible ways to prevent such relapses. To advance the research methodology, animal models are also used, though with respect to the emotional factor, as compared to the physical one, their application is rather problematic (Lovinger, Crabbe, 2005; Spangel, 2003). Many experts stress the significance of the co-existence of alcohol dependence with depression, stress, as well as genetic predispositions of addicted persons. It is commonly believed that alcohol consumption is associated with its capacity to reduce fear and anxiety (Preuss et al., 2002).

Alcohol dependence is a complex disease of the central nervous system characterized by a compulsion to obtain and consume the substance. It is a chronic disease in which relapses might occur even after a long period of abstinence. Understanding the mechanisms behind alcohol dependence might help in the search for new medications which would contribute to the development of a more effective pharmacotherapy of alcoholism.

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Addictive effects of alcohol

Abstract

Alcohol is one of legal psychoactive substances which are commonly consumed and often abused by people of all social classes. Alcohol is capable of changing the functions of individual organs and systems of the organism, as well as the structure and function of cells. Research studies have determined a significant correlation between prolonged consumption of alcohol, the generation of reactive oxygen species, and the increased risk for many disorders, including cardiovascular diseases, arterial hypertension, neoplastic diseases, or diseases of the nervous and muscular systems. The organ which is the most susceptible to its toxic effects is the liver. In acute and chronic alcohol poisoning, the excessive build-up of lipids in the liver may lead to chronic diseases of the organ, such as cirrhosis, hepatitis or hepatic steatosis. Continuous consumption of alcohol may also contribute to undernutrition and consequently a deficiency of many nutrients, including vitamins. Alcohol consumption also induces changes to the

carbohydrate and lipid metabolism in skeletal muscles. Its excess may lead to such conditions as myopathy, resulting in the atrophy of skeletal muscles. Changes triggered by the chronic or excessive consumption of alcohol can be observed at the structural, physiological and molecular levels of the organism.

Key words: alcohol, alcoholism, dependence

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Responsible Research and Innovation – how to develop RRI awareness among young people? European projects proposals and their results

Introduction – Why RRI?

As Bret L. Simmons wrote, "Today's problems come from yesterday's solutions" (2010). Such solutions included for example the use of asbestos – a mineral with unique properties: non-flammable, flexible, non-conductive of heat and electricity, resistant to chemical and physical factors. As a result, asbestos was widely used in the products applied in high temperature and in the environment of water, water vapour, active gases, organic and inorganic acids, greases, oils, solvents, exhaust gases, lye etc. (Szeszenia-Dąbrowska, 2008). However, the exposure to asbestos is a serious threat to human health. Although usually asbestos fibres are firmly linked, the mechanical processing of its products (e.g. cutting, drilling) and the so-called soft asbestos products used indoors in the form of thermal insulation or additives for paints and varnishes are dangerous to health and environment, and cause the emission of carcinogenic asbestos dust (Szeszenia-Dąbrowska, 2008). However, how did it all happen, despite the fact that in 1897 the first medical doctor linked emaciation and lung problems with the inhalation of asbestos dust, and the first documented fatal case related to the use of asbestos was reported in 1906, when the autopsy of an employee using asbestos revealed the fibrosis of his lungs; and in spite of the fact that it was not until 1970s when EPA (Environmental Protection Agency) and OSHA (Occupational Safety and Health Administration) began to legally regulate the use of asbestos (Barbalace, 2004), and in Poland the production of goods containing asbestos lasted until 1998 (100 years later)?

In order, among other things, to prevent such negative events in the future, but also to get closer to solving the most urgent social needs, such as the fight against diseases, access to clean water and adequate amounts of food, ensuring energy supply, waste disposal etc., the European Commission has been promoting the idea of *Responsible Research and Innovation*, the implementation of which is to contribute to better adaptation of the research and innovation process and its outcomes to the values, needs and expectations of the European society. In the description of the "Horizon 2020" programme one can read:

- There are times when science can seem to lose its connection to society and its needs, and sometimes its objectives are not fully understood, even if they are well intended.
- The lack of a common language and rapid progress in many areas of research has increased the public's concern or contributed to ambivalence about the role that science and technology play in everyday life.
- Europe wants to promote not only excellent, but also socially desirable science and technology.
- There is clear evidence that today we need to involve the whole of society in the decisions about the development of science and technology, so we can all contribute to the smart, sustainable, and inclusive growth of our societies (*Responsible research and innovation – Europe's ability to respond to societal challenges*, 2012)

What is RRI about?

According to the report by H. Sutcliffe (2011) RRI may be understood in the following ways:

1. The deliberate focus of research and the products of innovation to achieve a social or environmental benefit.
2. The consistent, ongoing involvement of society, from beginning to end of the innovation process, including the public & non-governmental groups, who are themselves mindful of the public good.
3. Assessing and effectively prioritising social, ethical and environmental impacts, risks and opportunities, both now and in the future, alongside the technical and commercial.
4. Where oversight mechanisms are better able to anticipate and manage problems and opportunities and which are also able to adapt and respond quickly to changing knowledge and circumstances.
5. Where openness and transparency are an integral component of the research and innovation process.

However, for the society to enjoy the opportunity to engage in the research and innovation process, it must have knowledge (science education) and be aware of the needs, opportunities (gender equality), conditions (ethics), objectives and have access to the plans and results of research, as well as proposals of implementations (open access).

RRI in the European Union projects

The first formal steps towards institutional support of RRI have been made as part of the Sixth Framework Programme (FP6), when the theme of "Science and Society" helped to increase the awareness among research and industry of the need to bring a range of research-related societal issues to the top of the policy agenda.

In 2007, the 7th Framework Programme entitled "Science in Society" was launched, and in 2014 – "Science with and for Society" (SwafS) came into existence across "Horizon 2020". In each of the projects, RRI has been a key element (*Research and Innovation. Science with and for Society. Evolution of the Programme*).

An example of an interesting project on RRI is **CONSIDER**, as part of which a web portal supporting the involvement of civil society in research has been developed (http://www.consider-project.eu/). There one can find an answer to the question: why would CSOs (Civil Society Organisations) be interested in participating in research projects? The answer is as follows:

- Because CSOs work on the ground, they are able to contribute field-based knowledge to research, drawing on tangible and relevant sets of feedback, data, studies etc.
- A CSO may want to act as a guardian for ethical issues in terms of methodology and outcomes.
- As research findings' may inform policy-making in a field that affects the interests or causes they represent, CSOs may want to get involved in order to help shape the research and favour a more evidence-based policy-making.

Moreover, practical tips for scientists can also be found in the web portal:

- Clarify your reasons for CSO involvement.
- Be aware of your local institutional support and recognition.
- Set your clocks: clarify likely timescales in advance.
- Agree on project management principles in advance (*Civil Society Organisations in Designing Research Governance*, 2013).

As part of the **Catalyst project**, an interesting model of communication between scientists and society has been developed (Fig. 1).

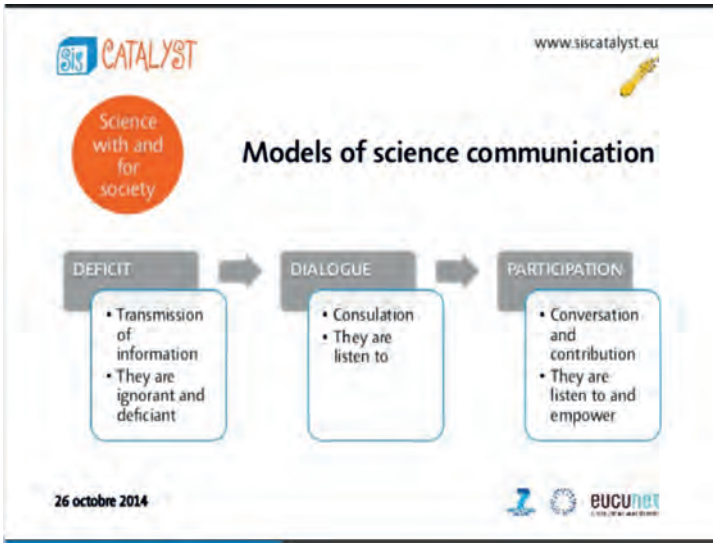


Fig. 1. Example of Project Catalyst materials (retrieved from http://www.siscatalyst.eu/)

An umbrella project, using the resources of many of the previous projects in the field discussed, is **RRI toolkit**. On their website all the necessary information, research results, activity outlines etc. have been published (Fig. 2).

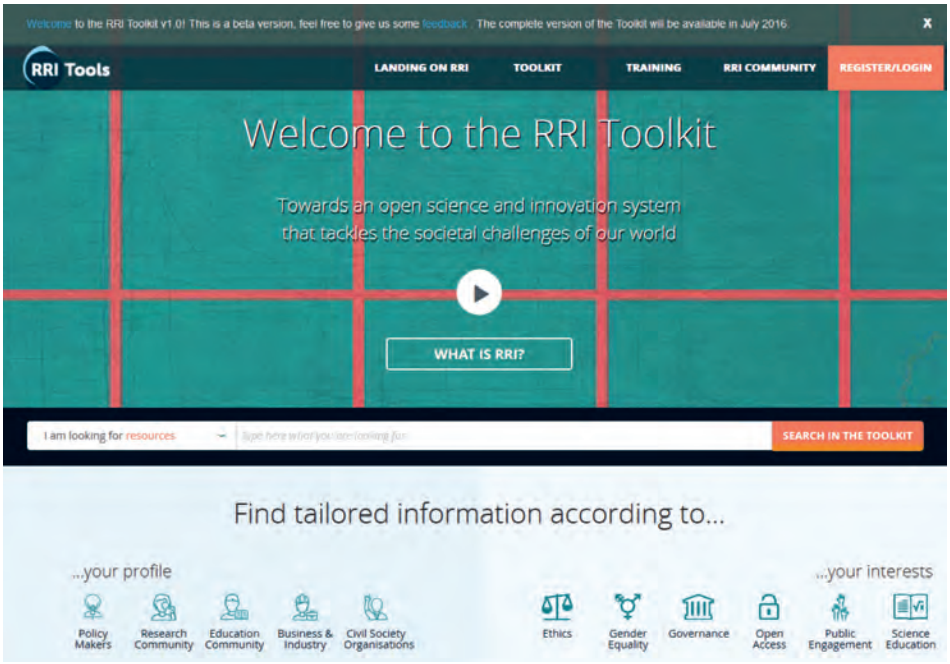


Fig. 2. RRI Toolkit (retrieved from http://www.rri-tools.eu)

The grant project of the **IRRESISTIBLE** (*Including Responsible Research an innovation in cutting Edge Science and Inquiry-based Science education to improve Teacher's Ability of Bridging Learning Environments*) acronym received funding in 2014 within the framework of activities coordinating and supporting the FP7--SCIENCE-IN-SOCIETY-2013-1 programme, activity 5.2.2 Young people and science, topic SiS.2013.2.2.1-1 Raising youth awareness to Responsible Research and Innovation through Inquiry Based Science Education. The work is coordinated by the University of Groningen (The Netherlands) with a Polish partner – the Jagiellonian University in Krakow (JU): Faculty of Chemistry and the Museum of the Jagiellonian University (Fig. 3). The main goal of the IRRESISTIBLE project is to design activities that foster the involvement of students and the public in the process of Responsible Research and Innovation.

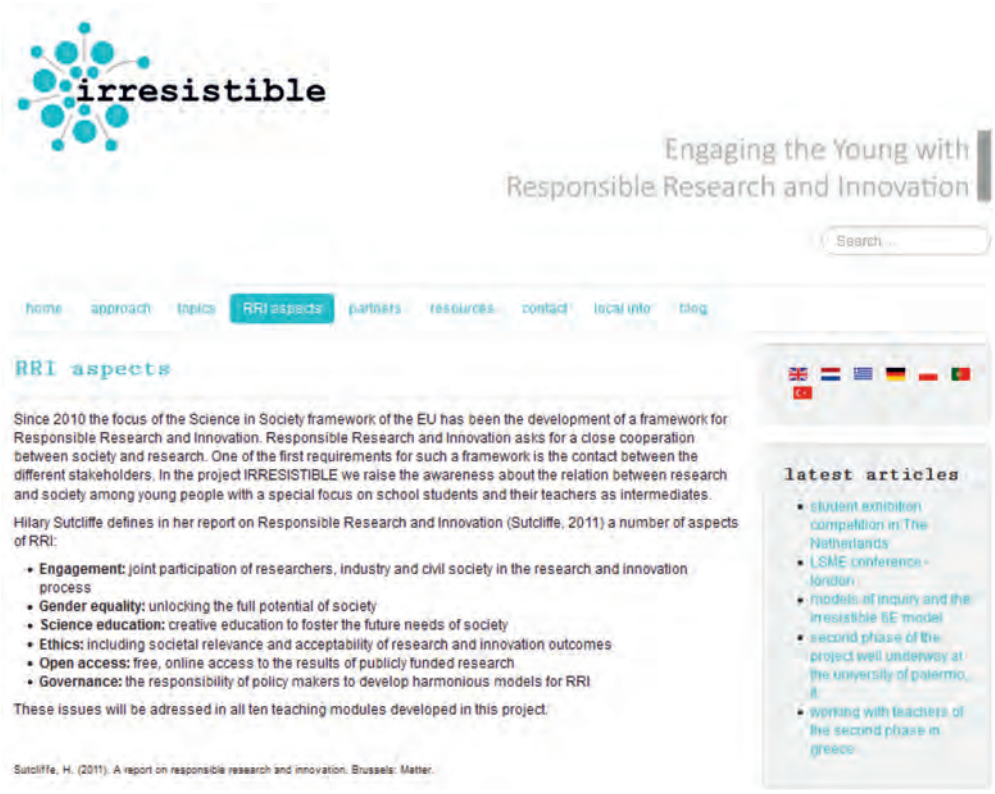


Fig. 3. RRI on the IRRESISTIBLE project website (retrieved from www.irresistible-project.eu)

How to develop RRI awareness – proposals of the IRRESISTIBLE project

Generally speaking, to raise the awareness on RRI, the IRRESISTIBLE project aims to increase students' content knowledge about Science by bringing cutting edge research such as nanotechnology into the school programme, and to foster the discussion among students about RRI issues by the introduction of relevant topics (IRRESISTIBLE project homepage, 2013). Wide public engagement is obtained for example by the preparation of students' interactive exhibitions.

In the first phase of the project the main task was to develop the modules: educational materials for teachers (lesson outlines) and students (worksheets, resources). One may say that in those modules RRI awareness was developed in two ways: in the form of CBL (Context-Based Learning), based on the example of such topics as "Nano in health sciences" or "Perovskite-based photovoltaic cells", as well as in the form of education in the field of NoS (Nature of Science) – classes dedicated to the discussion on how science develops, what the scientific method is, how scientists and research teams work etc. Some modules prepared in the project focused more on the selected items of RRI; other dealt with a number of RRI issues,

not necessarily closely related to chemistry, physics or biology, e.g. they concerned scientific career of women and their role in research teams.

In the teaching materials, ethical and ecological aspects of research conducted and innovations implemented are emphasized, especially those related to human health or environment protection. These include, for example, the release of nanosilver in the process of washing commercial products with bactericidal or bacteriostatic properties – the topic of experiments and discussions proposed in the module developed by Bogazici University, Istanbul, Turkey (Fig. 4).

Fig. 4. Nanosocks – an example of students' activity (Nano in health sciences, 2015)

After the students examine the table (with the results of professional research concerning socks and water after various number of washings), the whole class takes part in a group discussion based on the following questions (Nano in health sciences, 2015):

- *"When you examined the table, what change did you notice in the samples in terms of the amount of Ag^+ ions?"*
- *"What caused this change?"*
- *"What does the presence of Ag^+ ions in the wash water indicate in terms of antibacterial effect?"*

- *"Considering that the wash water goes into the drainage system as waste, how might the Ag^+ ions in this water affect humans and the environment?"*
- *"In your opinion, how should the wash water of nanoproducts be disposed of? Why?"*

In the "Plastic – Bane of the Ocean" module prepared by IPN Kiel, Germany, the problems with the distribution of nano-size polymer particles in the environment are discussed.

Catalytic Properties of Nanomaterials – a module developed at the Jagiellonian University in Krakow

At the Jagiellonian University, a module entitled "Catalytic Properties of Nanomaterials", dealing with RRI in the context of sustainable development and especially environmental protection (air pollutions, automotive industry) has been prepared.

In this module two ways of introducing the topic of RRI and its individual pillars (6 key issues) have been used. Some activities are more related to chemistry aspects of the subject matter, and other activities are of a less science-related context. The former ones include for example the discussion on the person of Fritz Haber – both the inventor of a catalyst allowing for the synthesis of ammonia from gases present in the air, which enabled inexpensive production of nitrogen fertilizers and thus limited the scope of hunger, and a person who worked on the use of Zyklon-B in the Nazi concentration camps.

Jagiellonian University also suggests to consider here the issue of technological innovation in the automotive industry, including a wide variety of energy sources (diesel, gas, electric, hybrid cars). In this case, a panel discussion was proposed, in combination with the roles method. Students prepared their opinions and stands, learning e.g. how to search for and critically evaluate information. In the game, they represented the enthusiasts of different kinds of fuel, experts, industry representatives, non-governmental organizations, car owners etc. Another topic was the issue of the use of catalysts which, on the one hand, significantly reduce air pollution with nitrogen oxides and soot, but on the other require for their production the consumption of non-renewable natural resources, e.g. rare earth elements, as well as proper disposal or recycling. Recently, two new real-life items helping to engage students in discussions, based on authentic press releases and Internet news, have been introduced to the topic: the so-called Volkswagen gate – actions aimed at falsifying car engines emission tests (Fig. 5) and the cases of removing particulate filters from Diesel engines (Fig. 6).

Fig. 5. Internet News – example 1 (retrieved from http://www.bbc.com/news/business-34857404)

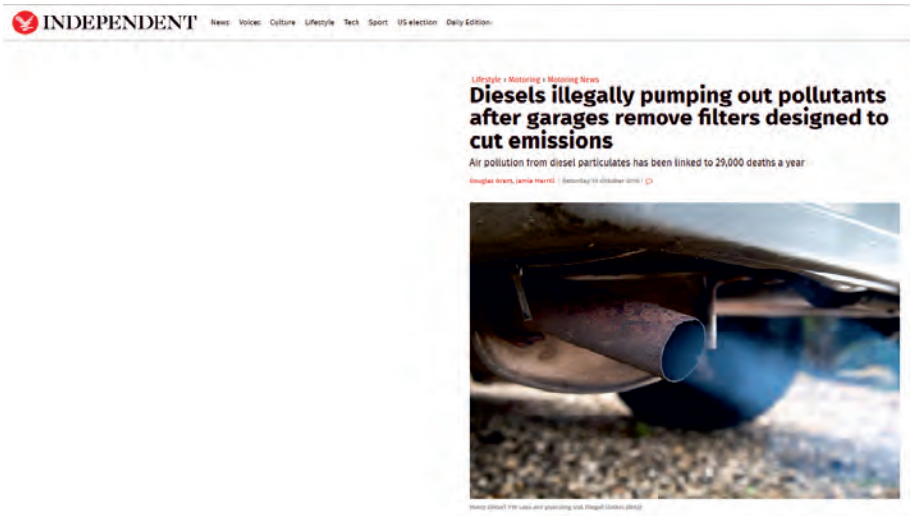


Fig. 6. Internet News – example 2 (retrieved from http://www.independent.co.uk/life-style/motoring/motoring-news/diesel-cars-illegally-pump-out-dangerous-pollutants-after-garages-remove-filters-designed-to-cut-a6689191.html)

Another approach implied the organization of classes focused on the process of conducting research and the work of research teams. In that case, the classes were based on group work, visits to research labs, discussions with researchers from the JU Faculty of Chemistry what is presented below.

Students worksheets – a tool for educational research

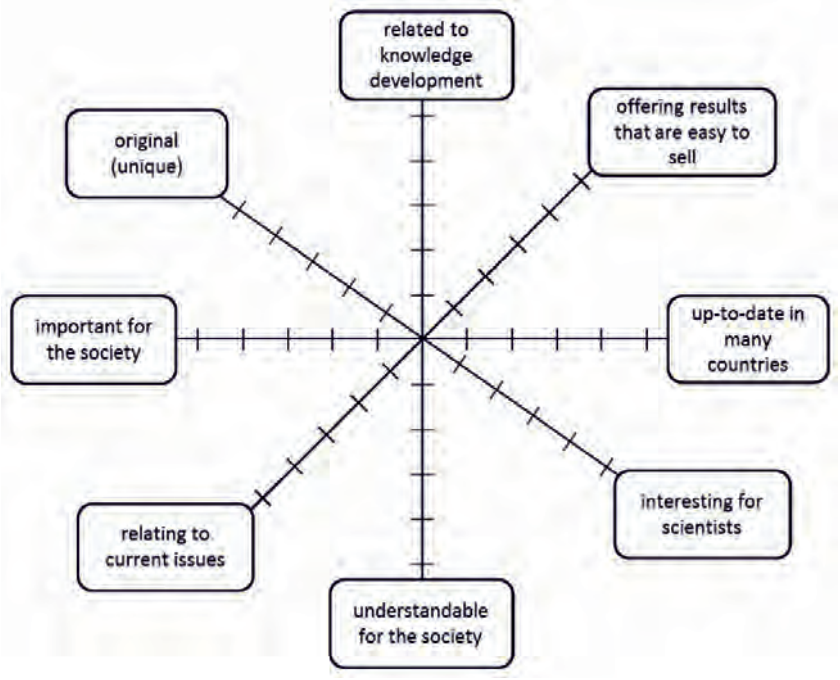
Below are presented worksheets of chosen students devoted to some elements of discussion about RRI issues developed by JU team (dr hab. Wacław Makowski, dr Paweł Bernard, dr Iwona Maciejowska) in the framework of IRRESISTIBLE project.

Research topics

1. What should be the features of a research topic?

Mark with a cross on the axis. If the feature is very important, mark near the outer end of the axis; if the feature is not very important, mark near the centre.

A research topic should be:



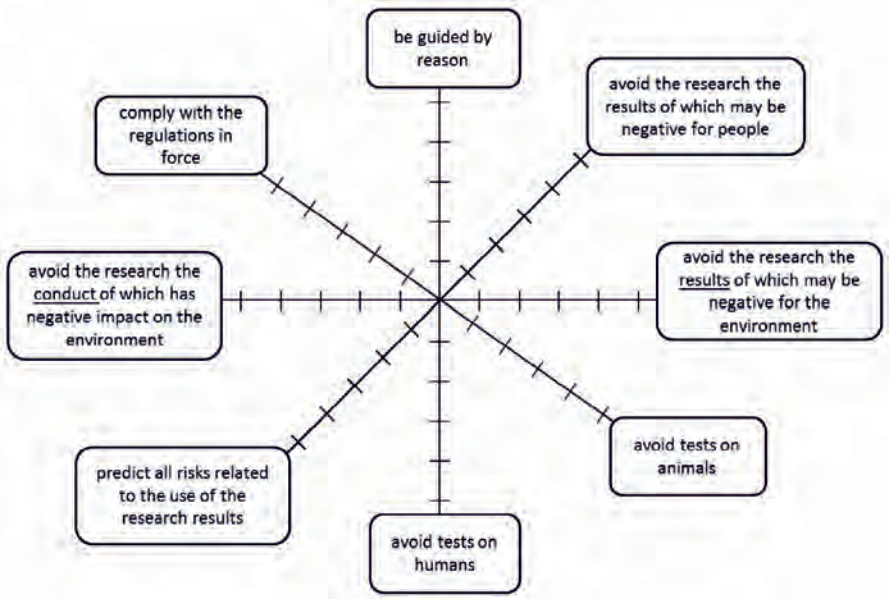
2. Mark one or several answers.

Who should decide on:	Scientists	Government	Society
a. the topic of the research			
b. science development directions			
c. industry development directions			
d. financing research			
The access to the research results should be granted to:			

3. Discuss your answers in the group, agree on the conclusions, write them down on the enclosed card, and then present them to the other participants of the meeting.

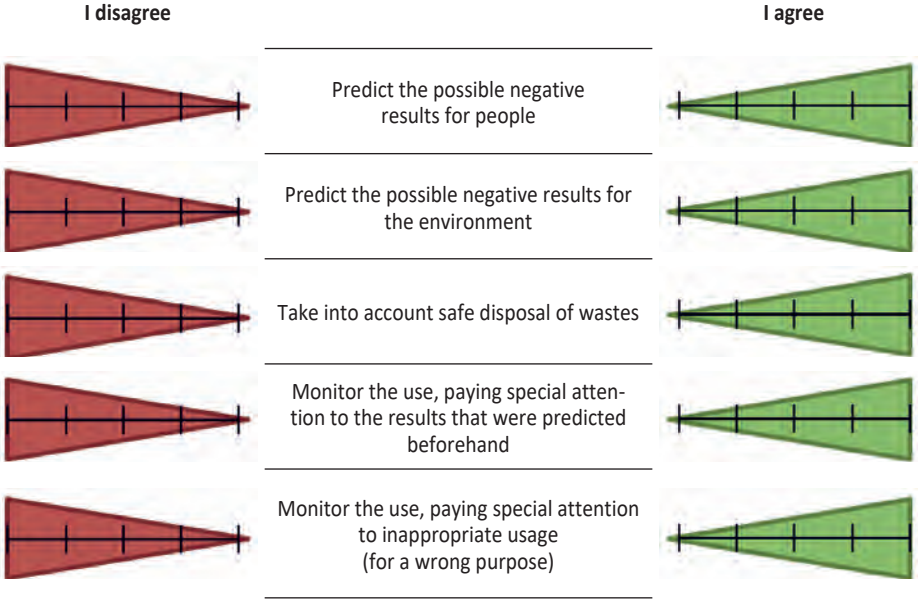
Ethics in scientific research

Scientist, when planning and conducting research, should:



Innovation and new technologies – implementation ethics

1. When implementing innovations and new technologies for widespread use, to what extent should the effects of their use be predicted? In the diagram below, select to what extent you agree with the following statements.
   Persons and institutions involved in the innovation implementation should:



2. Who bears the greatest responsibility for the consequences of the implementation of innovations and new technologies for widespread use? Arrange the items on the list in the order of importance:
   a) Government or self-government
   b) Producers
   c) Sellers
   d) Inventors
   e) Non-governmental organizations
   f) Users

   Enter the proposed order (from the most to the least responsible) in the following diagram.

The analysis of the school students group responses provides a picture of their prior knowledge on the topic. The analysis covered the worksheets of 14 mixed-gender groups of lower secondary school students (3–6 persons each), completed in the school year 2015/2016 in various schools in the Małopolska region. The frequency and intensity/importance level (where adequate e.g. radar charts) in the opinion of the students were compared.

Results

When analyzing the qualities that research should demonstrate, it can be concluded that students do not think that scientists should decide on the directions of the development of industry or financing research work (only one positive response out of 14), but definitely they should decide on the topic of the research (greatest number of positive responses). In the students' opinion, the government should be involved in taking decisions on all the issues the students were asked about, especially those concerning the funding of research, and the least the issues concerning the topics and directions of science development. To some extent, the society should also have a say in all topics (on average half of the groups indicated each element). According to the majority of the students groups (9/14), the access to research results should be guaranteed to all groups: scientists, government and society.

When analyzing the students' opinions on ethical aspects of research, i.e. the answer to the question: "*When planning and doing research, to what extent should they be guided by proper rules?*", one may notice that in the students' opinion scientists, when planning and doing research, should first and foremost comply with the applicable law (average "importance" of 4.6 on a scale of 0–5), and to a much lesser extent they should be guided by their conscience (3.4). There is definitely

no unanimity on the necessity to avoid animal testing, and it is a principle the least frequently selected by the students (3.8).

Interestingly, the students pay more attention to the effects of the research process or results on the environment (on average 4.1–4.2, respectively) rather than on man (3.9). It was confirmed by the results of the analysis of worksheets dedicated to ethical issues of innovations and new technologies implementation, where the most frequently selected was the response concerning the necessity to anticipate the possible negative effects on the environment. In this worksheet, the statement that turned out to be particularly unpopular was the one saying that individuals and institutions involved in implementation of innovation should monitor that process in terms of its inappropriate use (for the wrong purpose). In this case, 4 groups marked the opinion "I do not agree", although with varying intensity. Here the authors of such worksheets had in mind, among other things, multiply use of chemicals, e.g. herbicides used as war gases, or medicines used as illicit drugs. Perhaps the statement was not sufficiently clearly defined. Two groups did not agree either with the statement that people introducing innovations should take into account the safe disposal of the products used.

According to lower secondary school students, the responsibility for the consequences of the introduction of innovations for everyday use is distributed as follows (from the greatest to the lowest responsibility):

government or local government > inventors > manufacturers > NGOs > sellers > users

Conclusions

There are many strategies and methods of introducing RRI to formal and informal education, more or less related to the context of natural sciences. Mass media provide the descriptions of interesting cases, allowing to make the topic of responsible research and innovation relevant for students. It is worth using those examples in order to implement the rule of involving the entire society in this process. Many European projects offer interesting resources which can support teachers efforts.

Although the issue of misconceptions in chemistry has been so far discussed in numerous publications, including books (Barke et al., 2009; Taber, 2002), the misconceptions concerning the conduct of scientific research, operation of research teams and implementation of innovations are still "terra incognita". The one exception is the so-called "image of a scientist", e.g. in Saleh and Khine book (2011).

It is worth looking for the sources of large discrepancies between the assessment of the role of the scientist's conscience and the applicable laws, to the detriment of the former. This may be due to both downgrading the role of the personal assessment of the situation (conscience) in favour of external conditions (legal regulations), as well as to the exceptionally low level of social trust in Poland (see the results of the European Social Survey of 2014, in which Poland is ranked at the bottom of the

ranking of trust), in this case the belief in the high level of ethical competence of scientists. The studies allowing to compare the opinions on those issues of young people from Poland and other countries representing a different level of social trust would be interesting. The students' opinion on an insignificant responsibility of innovation users for the consequences of innovation implementation may confirm the thesis of declining the responsibility by young people, or speaking their language – of desiring to "release oneself from thinking". Especially the fact that the results of the discussions in two groups pointed out to the disregard for the problem of safe disposal of the products used must worry and requires corrective actions.

Derek Bok sad 15 years ago: "Taking citizenship seriously is, in the end, not a natural thing (…). Civic responsibility has to be taught in our schools and in our universities and reinforced by the media in later life and nurtured by all kinds of civic associations and activities in the society during one's mature years" (Bok, 2001). Those words are still valid especially in the context of Responsible Research and Innovation.

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Responsible Research and Innovation – how to develop RRI awareness among young people? European projects proposals and their results

Abstract

The need for research and innovations implemented in a responsible way is nothing new, but so far it has mainly concerned the scientific community. In the twenty first century, however, it is not enough and it is worth involving the entire society in the process. The main challenge is to find effective methods to encourage all stakeholders to participate in the RRI process. This task has been taken up by, among others, the partners of the educational project of the 7th Framework Programme, i.e. the IRRESISTIBLE project. The developed teaching materials are to assist teachers in the implementation of the RRI issues in the context of cutting edge science, using the inquiry-based (IBSE) teaching strategy, and in the development of non-formal education implemented in cooperation with museums and science centres. Module prepared by Jagiellonian University team proposes two ways of introducing the topic of RRI and its individual pillars (6 key issues): some activities are more related to chemistry aspects of the subject matter in the context of air pollution and car industry, and other activities are more located in the field of NoS (Nature of Science) – classes dedicated to the discussion on how Science develops, what the scientific method is, how scientists and research teams work. The results of the research conducted among lower secondary school students in Poland show the need to develop their sense of responsibility and the need of involvement of students in the process of responsible research and innovation, as well as the correction of some alternative conceptions related to that subject.

Key words: Responsible Research and Innovation, educational projects

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Secondary school students' perception related to Responsible Research and Innovation

Responsible Reseach and Innovation

According to Rapotem Directorate-General for Research and Innovation European Commission is determined to create a connection between the scientific community and European citizens (*Responsible Research and Innovation. Europe's ability to respond to societal challenges*, 2012). Responsible research and innovation can be understood through the effective cooperation between scientists, citizens, policy makers, business, third sector organizations, society during the process of research and innovation in order to meet the expectations and needs of society.

Quoting a report on Responsible Research and Innovation (Sutcliffe, 2011) RRI is about trying to get better at anticipating problems, taking into account wider social, ethical and environmental issues and being able to create flexible and adaptive systems to deal with these unintended consequences. This is sometimes called "Anticipatory Governance".

Hilary Sutcliffe defines 6 kye of RRI (http://www.rri-tools.eu/about-rri#in-short) (Fig. 1):

- ***Engagement:*** *all societal actors work together during the whole process in order to align its outcomes to the values,*
- ***Gender equality:*** *promoting gender balanced teams, ensuring gender balance in decision-making bodies, unlocking the full potential of society,*
- ***Science education:*** *creative science education to foster the future needs of society,*
- ***Ethics:*** *focuses on research integrity: the ethical acceptability of scientific and technological development,*
- ***Open access:*** *free and online access to the results of research,*
- ***Governance:*** *the responsibility of policy makers to develop harmonious models for Responisible Research and Innovation* (Maciejowska, Apotheker, 2014).

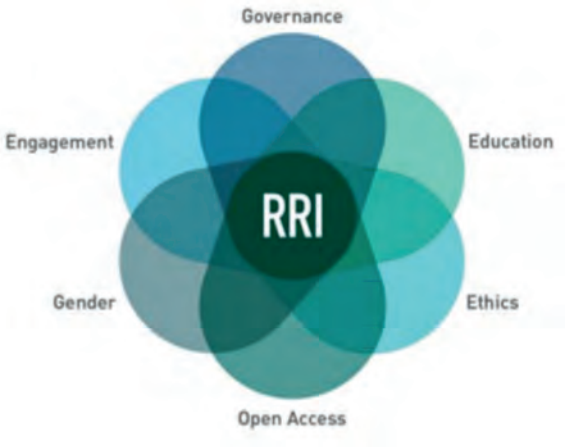

Fig. 1. RRI Key Components (http://rri-tools.cienciaviva.pt/about/)

Project IRRESISTIBLE[1]

The aim of the international project IRRESISTIBLE was the involvement of Young People in Responsible Research and Innovation and enhancing the knowledge of Nanotechnology. Implementation of this project took place among others on the team learning (community of Learners): scientists, teachers and students. During the annual work in 2015/2016 students under the guidance of their teachers discussed topics of Nanotechnology and nanomaterials, performed a series of experiments, taking into account the principles of IBSE. In addition, students participated in meetings with scientists, classes at the Museum, where they learned how to prepare an interactive exhibition (Kluza, 2016). The effect of it was preparing several exhibits for the school exhibition and two exhibits on the main exhibition. One of the exhibits was called Career Scientist (Fig. 2) and has been prepared based on the realization of the Principles RRI. During the classes students used the materials prepared by the International Consortium (Fig. 3).

[1] IRRESISTIBLE is a project on teacher training, combining formal and informal learning focused on RRI. It is a coordination and support action under FP7-SCIENCE-IN--SOCIETY-2013-1, ACTIVITY 5.2.2 Young people and science: Topic SiS.2013.2.2.1-1 Raising youth awareness to Responsible Research and Innovation through Inquiry Based Science Education.

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 612367 (http://www.irresistible-project.eu/index.php/en/).

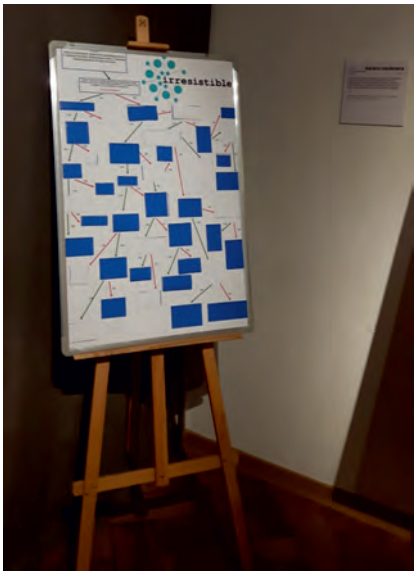

Fig. 2. The exhibit prepared by students: Career Scientist

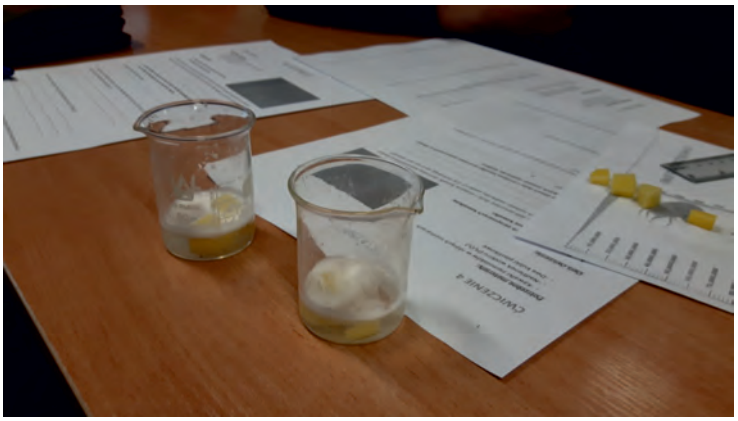

Fig. 3. The materials from the classes of project IRRESISTIBLE

Research of perception related to RRI

The issue of responsible research and innovation has been introduced based on the history of the use of asbestos, thalidomide, chemical, fertilizer etc. In the year 2015/2016 studies have been conducted on one group of students participating in the project IRRESISTIBLE. The study sample consisted of 50 pupils aged 13 and 15 years old. Participants were asked to answer a questionnaire (a survey of work) prepared by the international consortium, which was supposed to examine the opinion of students in five categories:

1. Features of the scientist
2. The topics of research
3. Ethics in scientific research
4. Innovation and new technologies, ethics during implementation
5. Research and Innovation – information

Results

1. Features of the scientist
   Task no. 1: How important are the following features for a scientist?

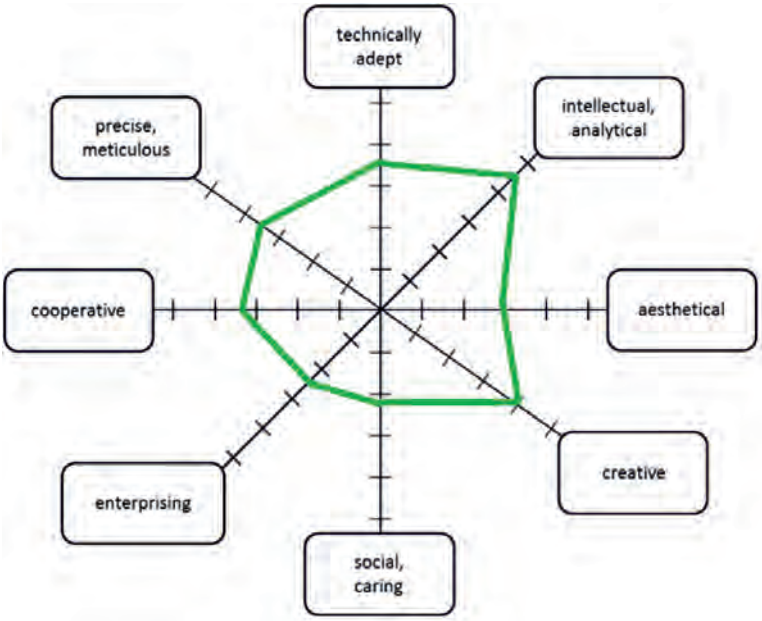

Fig. 4. Students' answers

Respondents jointly agreed that the most important feature characterizing the scientist should be creativity, intelligence, accuracy. According to the students it is equally important to be aesthetically pleasing and caring. Noteworthy response concerned cooperation with others. According to respondents, this capacity is not very important and not important for a scientist. With regard to the Research conducted by OPI (centre for processing information, http://www.opi.org.pl/Analizy-statystyczne-i-ewaluacja/newsId/47.html) one of the most important features that scientist should have are: leadership, interpersonal skills, teamwork entrepreneurship, decision making, planning and organization.

2. The topics of research

Task no. 2: What should be the features of a research topic?

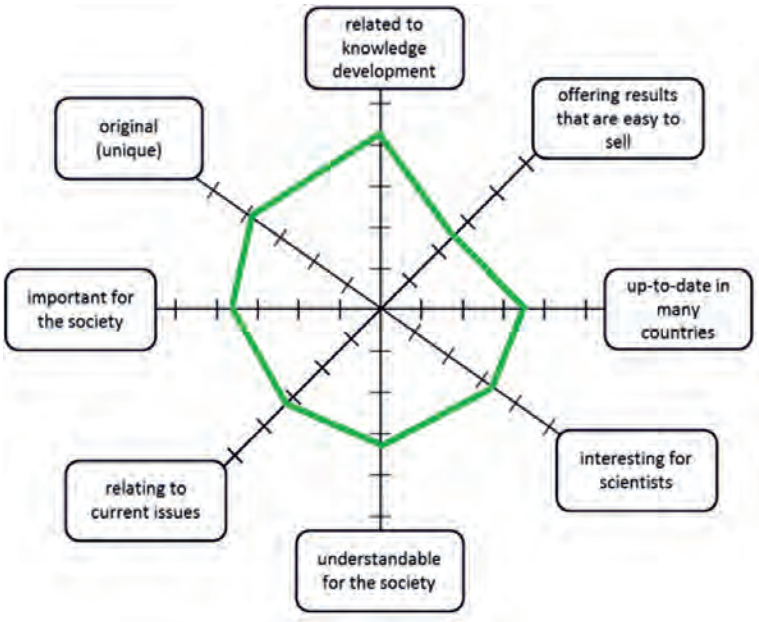

Fig. 5. Students' answers

Particularly noteworthy is that students think that during choosing a topic of research it is not very important whether the results can be easy to sell. Much more important was whether the subject will be related to development of knowledge.

Task no. 3: Who should decide on the topic of the research, science development directions, industry development directions, financing research?

Tab. 1. Students' answers

	Scientists	Government	Society
a. the topic of the research	85,7%	28,6%	52,4%
b. science development directions	75,6%	43,9%	36,6%
c. industry development directions	26,2%	83,3%	45,2%
d. financing research	26,2%	90,5%	45,2%
The access to the research results should be granted to:	92,9%	90,5%	90,5%

Students agree that the results of research should be available for everyone. According to the students the choice of research topic (85.7%) and the direction of development of science (75.6%) should mainly be decided by scientists. The government has a greater right to make decisions on the directions of development of the industry (83.3%) and on the financing of research (90.5%).

3. Ethics in scientific research

Task no. 4: Scientists, when planning and conducting research, should:

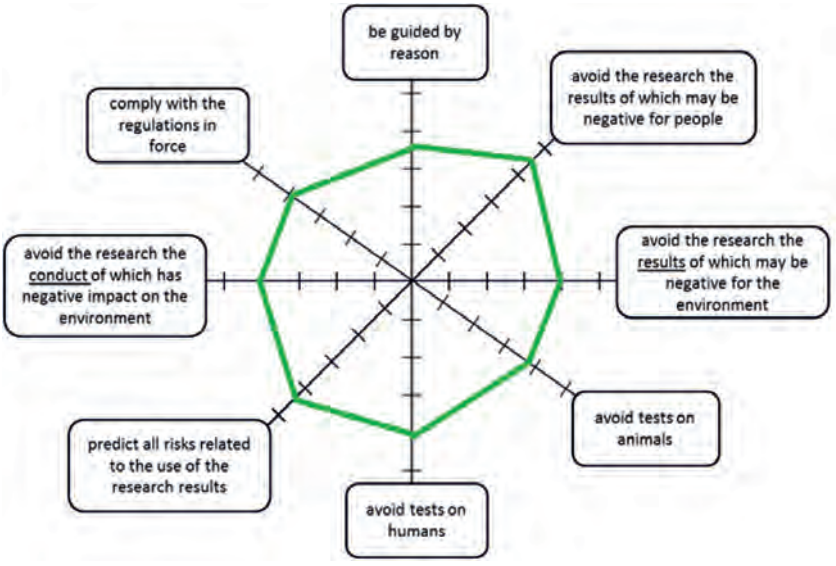

Fig. 6. Students' answers

According to the students during the planning and execution of research scientists should pay attention to many aspects. In their view, in particular testing on animals should be avoided, and the research which results can have negative effects for people.

4. Innovation and new technologies, ethics during implementation

Task no. 5: Who bears the greatest responsibility for the consequences of the implementation of innovations and new technologies for widespread use?

68% of respondents believe that the responsibility for the consequences of introduced innovations and new technologies to make the general public bear producers, 57% – sellers, 53% – users, 49% – investors, 33% – government or self--government, and 31% – non-governmental organizations.

5. Research and Innovation – information

Task no. 6: In your opinion, where can one find information on the latest research results?

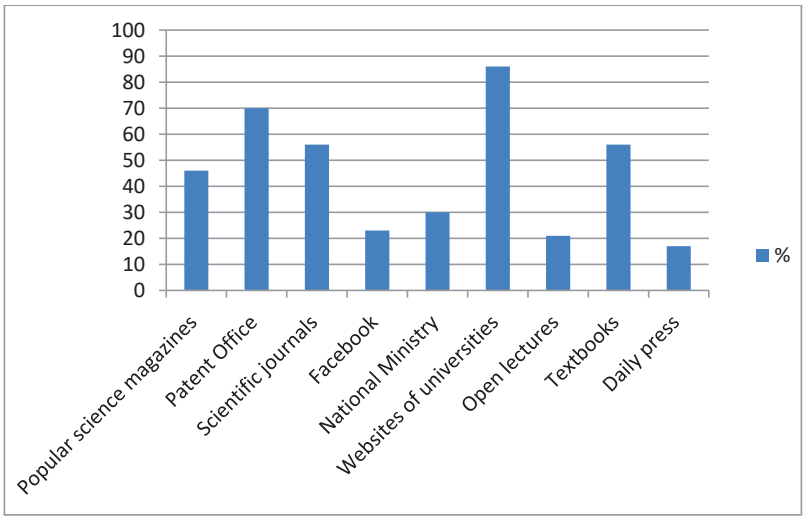

Fig. 7. Students' answers

Conclusions

The issue of RRI is a great way of pulling students in discussions about the future and scientific problems. An important element is the choice of subject, referring to the current scientific problems. Students often have a stereotypical image of a scientist who is working alone in the lab, does not wonder whether the results of his/her research will be to sell. According to the students researcher is mainly an intelligent person, creative and curious of the world, and his/her research is to develop the knowledge, and not desire to profit. Students are unanimous about the fact that the test results should be available not only to scientists and the government, but also for society. Noteworthy, however, is that on the choice of professional research, as well as on development directions of science or industry, should decide primarily one of the entities. The students do not see the need for cooperation and joint decision-making. According to the students ethics in scientific research plays an important role and scientists before they take up research must check and analyze the potential effects and risks that may carry their research. The respondents believe that the greatest responsibility for the consequences of the innovations bear the manufacturers and users. When it comes to searching for information on the results of the research, the students think the most reliable sources of knowledge are the websites of universities and research units, and the patent office, while social networking sites like Facebook and daily newspapers, despite the easy access, are not a source of information on scientific research.

According to the author, there is a strong need to get a social dialogue for those responsible for research and innovation. This subject is very important, and from an early age school should mention the issues related to the work of scientists. The

discussion could be hold, for example, during sports classes. The topics discussed should be about moral dilemmas in science, technology and the future of modern, scientific method and explanation of the world, history of scientific thought, great revolutionaries of science, Polish science researchers and their discoveries, science and technology, inventions that changed the world etc. (*Podstawa Programowa*, 2012).

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Secondary school students' perception related to Responsible Research and Innovation

Abstract

This article presents research results of secondary school students taking part in the project IRRESISTIBLE (Including Responsible Research and innovation in cutting Edge Science and Inquiry-based Science education to improve Teacher's Ability of Bridging Learning Environment). In Poland, the goal of the project was to broaden the knowledge about Nanotechnology and draw attention to the topic in forthcoming issues responsible for Research and Innovation (RRI). Particularly noteworthy are the opinions of the students on the role of the scientist in society, what are the important qualities of a scientist, and who decides on the research and processing and the introduction of the innovation.

Key words: Responsible Research and Innovation, scientists, IRRESISTIBLE Project

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Social media in communication and mediation of socio-scientific problems on the example of AIDS

Introduction

Generation C lives in the digital realm and is brought up in the Internet age. Digital natives are not only interested in searching for information, but, in the first place, in creating their own content and changing the reality they find. This has been made possible for them by the new media which support the use and creation of data and processing it into knowledge, also the one of the same medium (McLuhan, 2004).

User activity of Web 2.0. in educational contexts has been the subject of general interest to educators, including, among others, information architecture textbooks hypertext (Peel, 2002), the use of ICT skills in everyday life of students (Kaminska-Czubała, 2006), and the need to take into account the evolution of didactic media from the distribution of knowledge for communication and collective information processing systems, and the production of knowledge (Tapscott, Williams, 2007). This space, so far, has been the subject of exploration of Polish educators (Potyrała, Jancarz-Łanczkowska, 2014) in connection with models of learning specific contents regarding nature. The main aim of the current study was to investigate the activity of users of Web 2.0 during individual searching for information related to the selected topics of biology and environment of varying difficulty.

When considering the issue of socio-scientific problems we can say that they are made in a social context, they are multi-dimensional, open and contain links to conceptual learning. Subject has taken very specific, definite character. Negotiated problems are difficult to solve, but at the same time create the perfect backdrop for the transformation of education content and widening the perspective of cognitive students. The integration of current research results in the field of natural sciences with an innovative practice and regular monitoring of teaching science in the context of socio-scientific and public community network, deepen the understanding of the functioning model of social communication of scientific problems and the role of the new media. Creating or substitution of reality by the media becomes an impulse to development of conscious attitudes of senders and receivers of information. The

multiplicity of sources of information, the ability to use a variety of educational space provides an opportunity to experience the reality of nature. Allowing students to ask questions, arranging situations to promote open dialogue, debate, arguing and confronting different points of view becomes the driving force behind the development of creative activities. Contemporary media are focused largely on environmental issues, the diagnosis of the state of the environment, progress in the life sciences and their impact on the environment and human health. One of the most common questions are health issues related to HIV/AIDS, cancer, infections, mental and civilization illnesses.

In modern education the aspect of search for opportunities to update and deepen their knowledge has become very important. Creating a space of creative activity opens up new possibilities for the study of links and connections. Enrichment of already acquired knowledge gives you a chance to prevent attitudes of ignorance to the problems of the modern world, as well as preventing risks for human life and health behaviors. Lack of knowledge often influences malfunction, or failure response when it would be desirable to demonstrate initiative. All this creates a denominator of modern education.

Research aims

The aim of the research was to establish whether new media support social communication of socio-scientific problems and acquisition of social competencies by social networks including information processing and reasoning and questioning, as well as creating a model to learn science through social networks (connectivistic theory).

The study was performed by document analysis and content analysis of online resources with a help of a guide to copyright content analysis/documents.

Results

1. The substantive scope and methodical implementation issues of lifestyle diseases on the example of AIDS due to the requirements of the core curriculum of general education

Issues relating to civilization diseases are reflected in the core curriculum of general education of December 23rd 2008 in the form of a list of topics necessary for the implementation of the content and the competence of the students acquired at a given stage of education. In addition, the form of the general and specific requirements of the curriculum shows the teachers how to select teaching methods and techniques. At each stage of instruction is assumed to implement the content related to lifestyle diseases, including AIDS. A detailed list of the issues is contained in Table 1. Health education takes place not only in the nature and biology lessons, but also during the daily presence of students in the school, which should manifest

itself in appropriate behavior and school activities to promote the idea of caring for health.

Tab. 1. List of the issues concerning AIDS in the curriculum for general education

Educational stage	Issue
1st – grades I–III	The necessity of controlling one's health and following doctor's recommendations
	Attention of health and safety – one's own as well as other people's
2nd – grades IV–VI **subject: science**	Life and health threatening situations. Taking actions improving one's own and other people's safety. Conscious activity supporting healthcare
	Negative effect of viruses on human's health
	Behaviours and situations that can be life and health threatening
	Rules of healthy lifestyle and the necessity of implementing them
	The ways of maintaining, strengthening and preserving health
3rd **subject: biology**	Connection between one's behaviour and maintaining health
	Situations that require medical consultation
	Traits by which viruses differ from cell-built organisms
	Functions of the elements of the immune system
	Elementary rules of prevention of sexually transmitted diseases
	Diseases caused by viruses in human; rules of prevention of those diseases
	Routes of infection with HIV; rules of prevention of AIDS; individual and social outcomes of infection
4th **subject: biology, extended course**	Elementary traits of the structure of virion; life cycle of a virus
	Factors that influence disturbance of the homeostasis, including biological pathogenic factors
	Major viral diseases in human, including AIDS; routes of infection with viruses
	Situations in which immunodeficiency occurs, for example AIDS, and threats related to them
	Prevention of HIV infections in view of a very large amount of infections among young people conducted by promiscuity and inclination to risky behaviours
4th **subject: science**	Diseases associated with the progress of civilization as a threat to the world. Ways of avoiding them
	Biological aspects of health; internal and external factors that influence the state of health
	Information and statistical data concerning causes and occurrence of diseases associated with the progress of civilization

2. Polish foundations and associations for people with AIDS

In Poland, National Centre works, under the patronage of the Minister of Health. Its task activities are educational information and prevention of AIDS. The Centre also runs an online forum "plus and minus", for people living with HIV/AIDS, their families, and every member of the public interested in the subject. The forum has several thematic sections, which were visited by 750 to 68 500 users (most often discussed subject was living with HIV). From Centre's website you can know the details of social campaigns aimed at doctors, pregnant women and young

people making sexual contacts (one of the actions was to to download electronic Valentine's Day cards with information about tests for HIV and send it by e-mail to a beloved person). Until recently, there was a web portal Pastylka.pl which included the database on AIDS: scientific articles, educational videos and a forum comprising 86 plots, in which often also participated experts in the field of HIV/AIDS. There is also social website "zPlusem" which targets for HIV and AIDS patients, where those interested can set up their blog, publish documents and interact with each other in the created thematic groups. Among the NGOs works Foundation for Social Education. It runs educational activities using the web leczhiv.pl by enabling contact of those infected and their families with specialists in order to get answers to tough questions about HIV and AIDS. In turn, the foundation "We'll" has set itself for the purpose of educating, supporting and activating in the field of AIDS through research grants, educational programs (e.g. the board game "in hospital" was distributed among HIV-infected children) and portals for young people infected with HIV and their parents in this forum an opportunity to exchange experiences and support. Unfortunately, in the last nine months there were only 8 forum entries, and published articles on the site are occasionally commented. In Poland there is also an Association of Suffering from HIV/AIDS "Positive in the Rainbow", which aim is prevention of HIV/AIDS addressed to young people undertaking risky sexual contacts, and people who have recently learned about the infection. Health tips are granted by networking through various instant messaging, as well as events, happenings, concerts, projects and exhibitions. While the Association of Volunteers Against AIDS „Bądź z nami" ("Be with us") has the task of helping the spiritual, moral, psychological, social and material for people with HIV and AIDS and to promote tolerance in society in relation to the infected and sick. The Association runs its own helpline, trains the volunteers, updates service information, as well as distributes printed visual materials, and runs websites in the field of HIV and AIDS. On the website of the Association operates a forum, which is available only after logging in.

3. Resources of Polish educational portals

Scholaris.pl is a free portal, which resources, according to the authors, are "tailored to all stages of education, and the portal aims to support teachers in the preparation of interesting, often interactive activities by providing them with ready and proven educational materials". Scholaris.pl is to develop the skills of teachers and students in the use of information technology. It is one of the elements of the Government Human Capital Operational Programme. The portal supports a number of organizations including Central Examination Board, Białowieża National Park, Civil Development Forum, Nobody's Children Foundation. The portal Scholaris.pl placed a number of educational materials on the subject of AIDS and HIV. They are generally available to any Internet user who enters the portal page.

Analyzing the resources in category "biology – high school educational level", it can be stated that the subject matter is divided into the following sections: AIDS

and HIV, and AIDS as a social problem in Africa. Available materials were allocated into 4 categories: films and animations (8), multimedia presentations (1), materials practice (7), photos and illustrations (7). Details are included in Table 2.

Tab. 2. The list of topics published on the portal scholaris.pl

Topic	Number of views*
HIV and AIDS animation	1100
AIDS as a social problem – animation	1577
What do you know about HIV and AIDS? (questions)	871
Viral Odiseas of the immune system	667
Life cycle of the HIV virus	1669
Virus of acquired immunodeficiency	1007
Organism deprived of defence mechanisms	848
Pathogenic viruses	1632
Symptoms of HIV infection	933
Human Immunodeficiency Virus (HIV)	1511
How to fight HIV?	1016
Subject matters assigned for lower secondary school – secondary school	
Blood banks	1085
Viral hepatitis A	747
Polio carriers	649
Conversation	680
Organ donor/recipient	743
Test results and living with HIV	1026
Immunization schedule	999
Test for presence of hepatitis B virus	944
Routes of HIV infection	1064
Symptoms of viral hepatitis	1093

* (number of views from 17.04.2016)

The analysis of the number of views showed that the greatest interest is the subject concerning: the cycle proliferation of HIV (1669 views), AIDS as a social problem (1577 views) and pathogenic viruses (1632). Using materials proposed by the authors, you can get answers to questions, such as: What is the difference between HIV and AIDS? What are the ways of HIV infection? What is the cycle of multiplication of the HIV virus? What social risks are brought with AIDS? What are the symptoms of AIDS? What to do to not get infected with HIV? Presented topics correspond to the requirements of the curriculum subject of biology for junior high schools and middle schools.

Zadane.pl portal aids students about various educational issues. It was created for people who want to share their knowledge and abilities with others. Zadane.pl in Poland forms the largest educational community. The portal's users are mainly young people (pupils and students) and science enthusiasts. The portal was officially launched in September 2009 and since then has developed very quickly – statistics

from April 2016 indicate 5 096 386 unique users and the total number of page views of 35 935 045. The content of the site is divided into thematic sections, distinguishing between different objects and levels of education. Only registered users may ask questions, but all users may view the contents. We analyzed the available materials and questions for issues relating to social-science problems in the field of AIDS on portal Zadane.pl. The analysis results are presented in Table 3.

Tab. 3. Collation of issues regarding HIV/AIDS on web portal Zadane.pl

Lemmas and issues	Number of enquiries*
HIV	9720
AIDS	23 300
What is HIV?	4340
What is AIDS?	10 300
HIV life cycle	9
HIV infection symptoms	324
Human Immunodeficiency Virus (HIV)	1511
How to fight off HIV?	1016
Ways of contracting HIV	241
Life with HIV	1030
Life with AIDS	2100
Project about HIV	864
Project about AIDS	624

*(number of views as of 17.04.2016)

Participants have the opportunity to evaluate responses, commenting and expressing gratitude for the given answer using the button "Thank you". Under each of the posts you can see how other community members assess the response and on this basis it is possible to assess their credibility. Due to the fact that the contents are placed without prior verification one should consider the correctness of the information available on this website.

4. The analysis of blog.AIDS.gov and the profile AIDS.gov on the global social networking site – Facebook

Since the start of AIDS.gov on the 1st of December 2006 (World AIDS Day), the interest was increased in the use of new media tools to disseminate information on HIV/AIDS in order to raise awareness about prevention, testing and treatment. Blog. AIDS.gov was created by the US government and it is a place of public discussion on the effective use of new media to describe issues related to HIV/AIDS, present the latest research and social campaigns. The addressees of the blog are individuals and organizations that use or wish to use the new media related to the topic of HIV/AIDS, including: minorities and leaders in the field of public health; members of the public and the government; health care professionals and consumers looking for news about research. Contents on the blog are placed with the weekly frequency of new

audiovisual materials, authors' blog entries, entries by invited guests, and materials prepared by government organizations. In the White House, governmental blogs are devoted to infectious diseases.

The areas of blog content are, among others, to: 1) present and explain the use of new multimedia tools in the context of their use to inform about issues related to HIV; 2) inform about the threat and the proceedings in the case of being HIV positive; 3) indicate examples of the use of new media in the community of people living with HIV, including the report on conferences on this subject; 4) provide information on government policy of the United States on HIV/AIDS, and news about research; 5) promote prevention, treatment, research programs and initiatives, particularly the use of new media.

Blog.AIDS.gov has appeal to many social networking sites, like Facebook, Twitter, YouTube, Foursquare, Flickr, Pinterest. Blog readers can express their comments, share posts on their social networks to recommend to their friends. In 2016, 128 posts were published (as of 17th of April 2016), which have repeatedly been made available on other social networks.

Currently, Facebook is the most famous and popular worldwide social network that gives the possibility of contact, exchange and development interests. According to Wikipedia.org, project Facebook was launched in February 2004. Currently it has more than 1 billion users. AIDS.gov profile belongs to the Organization of American Government. The analysis was made for the most frequently discussed topics and the resulting questions or issues communicated by the person providing information (leaving comments, likes) on the profile of the organization. The profile has 40 740 likes (as of 17th of April 2016). The authors provide information that give the opportunity to increase the knowledge of users in terms of the dangers of HIV, its prevention, and awareness of the possibility of obtaining assistance in case of being a carrier. The profile beyond fulfilling the function of information, also gives the opportunity of discussion, but those are held in a very limited extent. The films represent an additional opportunity and incentive explore of the topic. Published posts contain links to articles about everyday life and problems of infected people. The questions posed by the authors are mobilizing to reflect and seek answers. They are made available to medical reports. The posts don't have many comments, which may point to the fact that HIV and AIDS are still a difficult discussion subjects for society. When analyzing the timeline we noted that user comments do not come only from the United States, but also from other countries, e.g. India. The comments usually take the form of the affirmative sentences, supporting the subject of the post. The articles to which links are posted on the profile are made available to the private profiles of people who "like" AIDS.gov, so you can reach an even wider audience. Very popular are reports of scientific conferences – like link of 6th of April 2016. "The National Youth HIV & AIDS Awareness Day" received a number of 202 shares. The information about the chat "Youth & HIV" on Twitter, which took place in April last year, received a number of shares that generated 71 111 of likes (as of 17th of

April 2016). Home abounds in a series of links to websites of other organizations dealing with issues of AIDS and HIV. The published article included stories of people infected by the virus. Many of them entails positive messages. The reported stories of people give hope that "HIV is not a judgment". The profile AIDS.gov creates the possibility to confront stereotypes and misconceptions about HIV and AIDS with the latest research reports. Relationship with the life of people infected and sick shows the possibilities to seek help or support. It is an opportunity to exchange views and establish contact with organizations and individual supporters to get reliable information in social-scientific problems in the field of AIDS and HIV.

Conclusions

Contemporarily, an aspect of searching for the opportunity to update the knowledge has become very meaningful in education. Enriching already gained knowledge gives a chance of avoiding attitude of ignorance to the problems of the modern world, and a chance to counteract behaviours that are risky to people's health and live. The lack of knowledge is often enough, followed by mistaken actions or not reacting when taking up the initiative would be the right thing to do.

Nowadays media often focus mainly on environmental issues, progress in life sciences and its impact on human health. One of the most often discussed questions concerning health are those concerning HIV/AIDS, tumours, infections, mental illnesses and diseases associated with the progress of civilization.

The most popular themes in educational web portals are those concerning questions of the HIV viral life cycle, AIDS as a social problem, and pathogenic viruses. The user can obtain information about the difference between AIDS and HIV, routes of infection, symptoms of AIDS and ways of avoiding infection with HIV.

The themes presented in educational web portals correspond with the demands of the core curriculum for biology in secondary schools and high schools.

The posts in social media are rarely commented, which points that AIDS and HIV are still difficult topics in our society.

Web portals support gaining reliable information relating to socio-scientific problems concerning AIDS and HIV.

Since the issues concerning AIDS emerged in the social networks, a growth of interest in using new media tools to diffuse information about the topic was observed.

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Social media in communication and mediation of socio-scientific problems on the example of AIDS

Abstract

Educational needs of the C generation, as well as the fast growth of informational resources of the Web, are reflected in social media. Prosumerism has its outcomes – the more consumers of information become its producers or proactive consumers, the more a well operating apparatus of didactical media is needed. The attention is focused on the range of utilizing website navigation systems (sets of websites and links), tagging, searching and types of links utilized by the netizens who use the data (Rosenfeld, Morville, 2003).

The main aim of the research was to establish whether new media support social communication of socio-scientific problems and acquisition of social competencies by social networks. An analysis was made of the core curriculum of the general education in terms of a range of issues relating to AIDS, of the web pages of foundations and associations for people with AIDS and of resources of educational portals and blogs devoted to AIDS. It has been shown that modern media raise issues of health education, and social networks are increasingly used as new media tools for communication of socio-scientific problems regarding civilization diseases, including AIDS.

Key words: social media, scientific communication, SSI, AIDS, HIV

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Responsibility in the process of mediation – in terms of pragmatic and ideological

"You are responsible forever, for what you have tamed"
Antoine de Saint-Exupery

With the passage of time, it is seen how much has changed in Poland from the time of introducing first mediations to Polish law and practice in judicial proceeding. From 1997, when mediations appeared in criminal cases, the possibility of their legal and (what is more important) practical application moved on to the canvas of the civil, family and economic, and many other disputes. From January 2016 the *Act on mediation*[1] is available for Polish mediators. In this Act a legislator not only focused on the most important formal issues, but also on ethical issues concerning leading and organization of mediation process and the requirements (qualifications and some of competences) that the candidate for mediator shall meet. Development of mediation is also noticed in scientific area through the increasing number of publications and surveys in that field.

However, with the increase of knowledge about mediation and also of the expectations of the organizers, the need of understanding of what the responsibility in mediation is, and what the role of all the participants of this process is, also increases. Maciej Bobrowicz – a lawyer and a mediator – commented on that issue synthetically. He wrote, that "the conflicted sides are responsible for the outcome of mediation; a mediator is responsible for effective management of negotiation process. A representative agent is not formally responsible for the course of mediation". But what is the basis of this synthesis? Which conditions, factors and legal and moral premises are hidden by words "responsibility in mediations"? What is the distance between the idea of mediation (its essence, imagined ideal state) and the practice, reality and daily work of court mediator?

The basis for reflection about responsibilities in the occupation of mediator are, of course, *Standards of Leading Mediations and Mediation Proceeding* and *The Code*

[1] *Small Law Mediation* is a government document containing all existing provisions on mediation and mediators in force in Polish *Codex of Laws*. The Act was adopted in 2015, and came into force in January 2016.

of Mediator's Ethics created by The Polish Centre of Mediation with the cooperation of many professional mediators, and also all of the normative acts defining directly and indirectly the role, tasks and obligations of the mediator.

Responsibility in mediations

To talk about responsibility in mediation process we should first ask what this responsibility is, how should it be understood. It is difficult to find in Polish legislation articles directly explaining the range of mediator's responsibility, but it is a mistake to say that there are none.

Mediator's responsibility is the consequence of realization of his/her designed tasks, functions (including his/her competences and qualifications[2]), and also it is directly connected with the rules of mediation. The rules of mediation have two sources: legal (then they are called *codex rules*) and moral, ethical, resulting from the rules of social coexistence and the special needs of mediators and the sides of mediation (they are called *except codex rules*), written as *The Code of Mediator's Ethics*[3]. Therefore responsibility not only is expected, but also – and mainly – inalienable and incontestable value of the whole process.

Mediator's responsibility is seen in some areas:

1. Formal,
2. For the organization of process,
3. For the realization of rules of mediation,
4. Ethical/moral,
5. For the balance of the parties.

1. Formal responsibility

A very important mediator's task is to prepare documentation connected with the process of understanding that is led by him/her. It is radically different from court acts although it is equally important for the court, that after a finished mediation process, independently of the outcome, receives documents. Preparing it, the mediator should remember about a principle of confidentiality, to which

[2] The main reqirements for mediators and their tasks and aims of mediations are presented in *The Civil Code*, but some cases, e.g. family or criminal, can be lead by mediators meeting additional conditions, defined in other acts. It is worth to remember, that "a mediator can be each natural person, who has full legal capacity and enjoys full civil rights. However, a judge (except for a judge at rest) cannot be a mediator. In cases of divorce or separation and family or tutelary (unless the parties agreed on mediator), a court sends to the permanent mediator, who has theoretical knowledge, especially who is educated in psychology, pedagogy, sociology or law, and has practical skills in leading mediation in family cases" (Rękas, 2010, p. 26).

[3] *The Code of Mediator's Ethics*, created by one of the biggest association organizations of mediators – Polish Centre of Mediation (PCM), is a document that is obligatory for all mediators. However, each organization dealing with mediations has the right to create its own additional rules, mediation conditions and criteria for mediators.

he/she is obliged. This rule concerns also further way of collecting[4] and keeping documentation.

Documentation preparing by mediators should be primarily: a written consent to mediation from the parties of proceeding, a consent to the processing of personal data, a mediation contract, a report on the mediation and a final agreement. Moreover, most of mediators prepare additional documents having different roles in mediation. There are: "invitation" for mediation, cards of rules, short personal questionnaires and others. **The consent to mediation** is a basic document, outputting to start the whole process. It is closely related to a principle of voluntariness, because the parties express a wish for participating in meetings with mediator in it, and to a principle of acceptability (and at least one of the elements of its realization), because the parties express the acceptance for this, defined mediator. Essential is also **the consent to the processing of personal data** for the purpose of realization of mediation process according to the provisions in Act on the Protection of Personal Data from 1997 (Dz.U. z 2016 r. poz. 922).

The other main document is **the mediation contract** (called also a mediation agreement), that determines the object of conflict, conditions and rules of mediation, its participants, points the person of mediator or at least the way of choosing him/her, costs, type of case, other additional conditions[5]. It is an agreement that gives a warranty to the mediator to take action and lead the process. **The request for mediation** is a document created by the mediator (or with the parties) to the court, after the mediation contract. The request usually consists of parties' data, the obcject of conflict and possible claims, signatures of the parties of conflict, nesessary attachments and a copy of the mediation contract.

As Agnieszka Rękas (2010) stresses, the request as a document is not a kind of pleading, so that its form and contents can be different from such papers.

If the parties during the mediation find a rewarding solution and reach an agreement or even become reconciled, **the final agreement** is written. It is a main purpose, a point of pursuance in the process of mediation. The final agreement made in front of the mediator requires confirmation by court "to produce effects such as in case, when parties make an agreement in front of court" (Rękas, 2010, p. 29). The final agreement contains all the parties' resolutions and declarations connected with the way of conflict solution, terms of realization of these resolutions and the other elements important for parties.

One of the last documents is **the report (or the protocol) on the mediation**, that is undoubtedly the element that arouses anxiety among the conflicting parties and young, unexperienced mediators. An experienced mediator knows that this

[4] In practice, mediators do not keep notes nor additional information, because they are unnecessary. Generally, backups of obligatory documents sent to courts and for parties are kept.

[5] In civil cases it is acceptable to make oral agreement and also oral consent to mediation. However, in practice, every professional mediator prefers written form of documents.

document contains nothing more, but only data of parties participating in sessions and the result of mediation proceeding in the form of a message if an agreement was reached or not (when mediation stopped or parties did not agree to mediation). The report contains also an information about where meetings took place and about the number of conducted mediation sessions with terms and duration (from... to...). Such form is a consequence of realization of the principle of confidentiality, but the minimalism of the report functions also as a kind of diminish bureaucracy, and even it is a system of alternative methods of solving conflicts in Poland.

In this case the formal responsibility is connected with some issues. Undoubtedly, very important is to distribute documents to court and parties. Formal defects can also appear, that result in documents not being received by court, and that need to be completed (e.g. lack of signatures, inconsistency of data). Problems can also appear when there is lack of necessary attachments, or wrongly constructed paper, or incorrect form of the final agreement.

It is worth to mention here about "contract responsibility" (*ex contractu*). In accordance with article 471 of *The Civil Code* ("the debtor is obliged to repair the damage resulting from non-performance or improper performance of obligations, unless the non-performance or inadequate performance is the result of circumstances for which the debtor is not responsible"[6]), the mediator is responsible for causing damage to the parties of mediation proceeding. It is a result of using substantive law in relation to mediation. According to article 471 of *The Civil Code*, a damage can be a result of breaking, breaching of a mediation contract signed with parties, whereby they suffered losses.

2. Responsibility for the organization of process

The main organizer of process, it can be said "a stage designer" (but not "a director"), is the mediator. The organization of process consists of some essential elements. One of them is to create documentation. A process is something that lasts in time and place and has a defined purpose. Therefore the mediator is responsible for organizing and adaptation of a place, where mediation will take place in a way, so that conditions will be comfortable, favoring for realization of mediation rules, and not overwhelming. A place should reflect the principle of neutrality, so that the parties can participate in the process without embarrassment and should guarantee the respect for the principle of confidentiality.

Organizing a mediation process, a professional mediator remembers about main stages of the whole process. It starts from individual meetings with each party, when the mediator is obliged to inform parties about the rules of mediation and explain what the process is and what the mediator's role is. He/she should make sure, if parties understand the rules and other issues. Then there are so-called common sessions, when parties verify their positions, regrets, expectations, claims

[6] Dz.U. z 2016 r., poz. 380 z późn. zm.

and, with the help of mediator, try to find solutions (possible, acceptable, satisfying). The model course of mediation (Kalisz, Zienkiewicz, 2014) should consist of those following stages:

- Parties' decision and initiation of the mediation process,
- Preparing the mediation, including preliminary diagnosis of the reasons of conflict and its object,
- Initiation of the mediation sessions,
- Presentation of the parties positions,
- Defining the main problem,
- Exchanging of suggestions of solutions,
- Working out a common solution,
- Writing the final agreement,
- Closing of the mediation sessions,
- Introduction of terms of the settlement into force.

Mediator cannot/should not[7] suggest solutions for parties, nor offer them directly. Solutions should be an initiative of conflicted parties, because of the fact that they are – as a result – responsible for the realization of solutions, not the mediator.

3. Responsibility for the realization of rules of mediation

The rules of mediation are clearly defined in *The Code of Mediator's Ethics*. They are canvas for all the mediators' actions and behaviours in Poland. Each mediator, when initiating the agreement process, is obliged to present the rules of mediation, that are obligatory in the process, to the parties. In some cases the parties generate their own additional rules, important for them during the mediation. Still, the basis are five primary rules[8]:

- Confidentiality,
- Voluntariness,
- Impartiality,
- Neutrality,
- Acceptability.

It is stressed above, that many of Polish associations and other organizations leading mediation actions have also their own, additional rules. It is also necessary to remember that participants of mediations have the right to introduce their own

[7] There are various schools of conduct mediations. In most of them it is considered that the mediator cannot suggest solutions, according to assumption that he/she is not in parties' place. Only parties are able to specify their own needs and expectations. However, it sometimes happens that mediations are conducted in coactive, more facilitative way, where the mediator can provide feedback regarding to solutions and suggest other ideas.

[8] All the rules were described in detail and presented in publications: A. Rękas (2010), *Czy tylko sąd rozstrzygnie w sporze? Mediacja i sądownictwo polubowne*, Warszawa, and A.K. Duda, J.M. Łukasik, *Mediacje jako alternatywna metoda rozwiązywania sporów w szkole*, Debata Edukacyjna, 4/2011, Kraków.

rules that are important for them from the perspective of calm and correctness of mediation proceeding or – what is more important – guarantee of the feeling of safety and confidence for parties.

Because of law, but also of emotional reasons, it is the principle of confidentiality that encumbrances the mediator most. Its breaking by mediator can cause damage in accordance to article 471 od *The Civil Code*. What is more, it is mediator's responsibility from article 72 of *The Civil Code*, where it is written that in case of infringement of the principle of confidentiality[9], mediator should repair the damage caused and give back all the derived benefits to parties or satisfy.

> ***Art. KC 721*** *§1. If the negotiations party has provided information on a confidential basis, the other party is obliged to disclose and not pass on to others and not to use such information for their own purposes, unless the parties agree otherwise.*
>
> *§2. In the event of non-performance or improper performance of duties, referred to in §1, entitled may claim from the other party damages or release of the benefits it received* (Dz. U. 2016 poz. 380).

Confidentiality also includes all the participants who are not the parties of conflict. *Ex lage* confidentiality refers also to the fact, that mediation has no witnesses, it is an implicit process. However, by way of exception, upon a common request (by common consent), experts, chartered, legal protectors can be joined to mediation. It also happens that mediations are conducted with the participation of lawyers, representative agents or (what is very rare) middle agent. All these participants, such as the mediator, are obliged to follow the principle of confidentiality. Responsibility of the third party is mentioned in article 474 of *The Civil Code*.

It is worth to mention, that the principle of confidentiality is so hardly established by law, that even calling the mediator as a witness to court in a case, where he/she had led mediation that had not finished with agreement, is ineffective. Court dismisses *ex officio* such a request.

However, very important is notation functioning in Polish legislation, on which the court can exempt from the principle of confidentiality and implicit of mediation. Such situation concerns having by mediator information connected with terrorist threat and the other threat for the state security. According to article 240 of *The Penal Code*, mediator is obliged to notify the competent authorities of the crime.

> ***Art. 240KK****. §1. Who, having reliable information about punishable preparation or attempt or execution of an offense referred to in* ***art. 118*** *extermination,* ***art. 118a*** *part in a mass assassination – criminal liability,* ***art. 120–124, art. 127*** *coup,* ***art. 128*** *attack on the authority of a constitutional Republic,* ***art. 130*** *espionage,* ***art. 134*** *attempt on the life of the President,* ***art. 140*** *terrorist attack,* ***art. 148*** *murder,* ***art. 163*** *to bring the incident,* ***art. 166*** *piracy,* ***art. 189*** *deprivation of human freedom,* ***art. 252*** *take a hostage*

[9] Although the article 71 of The Civil Code refers to negotiations, it also refers to mediations that can be compared with "supporting negotiations".

or terrorist offenses, does not inform immediately the body responsible for prosecuting criminal offenses, is punishable by imprisonment up to 3 years.

Breaking the principle of confidentiality can also held mediator responsible in tort (*ex deliktu*). It means that mediator can be responsible for this offense as for a prohibited act according to art. 415 of *The Civil Code*.

Art. 415*. Who is the fault of his damage caused to another, is obliged to repair it.*

This regulation refers also to other rules of mediation. According to the principle of voluntariness, the parties have to express an agreement to participate in the process together, but even after joining the mediation they have the right to resign without giving a reason. The mediator also can use the right to refusal to conduct mediation, but only because of important reason. The obstacle in the organization of mediation process can be the fact of affinity or kinship with at least one of the parties or involvement in the conflict (therefore he/she cannot be neutral to the object of conflict). However, if he/she refuses to mediate without giving the important reason or if he/she undertakes on this task despite existing obstacles, and the parties as a result suffer loss (damage), the art. 415 of *The Civil Code* can be used.

4. Ethical/moral responsibility

Ethical and moral[10] doubts referring to the correct realization of the process, proceeding following the rules of mediation, are extremely common phenomenon in the occupation of mediator. On various social networking sites, world web sites and forums dedicated to mediators there are very common questions asking for help or advice connected with ethical issues. The most common examples (appearing in literature dedicated to mediators and on the Internet sites mentioned above) are problems connected with: suggestions, extreme diversity of beliefs that harm the mediator, confidentiality.

In mediations essential is to initiate all the solutions and suggestions of actions by parties. However, there could be situations, where parties act (in the consequences of realization of following decision in the agreement) on their own against each other or even come into conflict with the law. The mediator has available only his/her own workshop equipped with communication techniques. The mediator cannot be responsible for the final decision of the parties regarded to the form of agreement and the way of its realization that takes place outside the mediation. In case when some points cause clear doubts it is possible that the court rejects the decision of such an agreement or changes its shape.

A difficult situation, especially for young unexperienced mediators, can be extreme diversity of beliefs from those that are represented by parties. However, it is necessary to remember about one of the key rules of mediation – the principle

[10] The rules of mediation, their interpretation and a role of mediator were prepared as *The Code of Mediator's Ethics* by The Polish Centre of Mediation (2003).

of neutrality to the object of conflict, parties and their relationship. The mediator should be focused on supporting the parties in striving for agreement regardless of expressed parties' beliefs, opinions, values and confessions.

A different situation is when the mediator is aware of applicable regulations and knows his/her own competences and qualifications in mediations, but he/she starts to lead mediation despite of lack of permission. This situation can happen for example in criminal mediation, because it requires additional permissions allowing to the matter. These permissions are: age (completed 26 years), knowledge about psychology, pedagogy, resocialization or allied sciences and experience in mediation. In cases of civil mediations, when a mediator can be a person who completed 18 years old, there is an obstacle that makes leading mediations impossible – deprivation of public rights. It is, however, acceptable, that if – despite of lack of formal permissions – parties achieved a solution and made a satisfying agreement, the mediation is considered as valid and not incorrectly conducted. But when the process is considered as incorrect, there is not only mediator, but also the organization (that recommends the mediator and inscribes him/her on the list of permanent mediators) that incur responsibility.

5. Responsibility for the balance of the parties

The balance of the parties is one of the except codex rules of mediation. Its realization has special significance in achieving the parts' common satisfaction of accepted solutions. In situation, when one of the parties is much more dominant in the process than another, the mediator's task is to strive to balance both of the parties. This rule seems to exclude with the principle of impartiality, but the balance of the parties is not on the unilateral strengthening, but a responsible organization of the communication process between the parties. This rule is also realized through choosing the place for mediation that is not linked closely with the parties (for example it is not a place of residence or a workplace for any of the parties). Individual meetings are conducted in the same or similar conditions so that none of the parties feel favoured. Lack of respect for this principle usually results in breaking the mediation by one of the parties. In that case the mediator does not bear legal responsibility, although such experience can affect in a negative way on mediator's morale and self-esteem.

Summary

Mediations in Poland develop, implanting in many fields of law and daily life. With the progress, the level of mediator's responsibility for the mediation process increases. The mediator bears not only law responsibility, but also ethical responsibility, that is the biggest warranty for this occupation allowing to use the word "professional". For not because of regulations, statutory rigors and courts' expectations the high quality and mediator's engagement results, but for the deep belief in the power of agreement, belief in human goodness and the value of which is justice.

Therefore, responsibility imposes on the mediator a number of additional duties, but it also makes that – as internalized value – responsibility can become "propulsion motor" in an effort to make professional the occupation of mediator and an indication on the path to true justice and reconciliation.

Responsibility for the process of all the participants of mediation occurs when the agreement between the mediator and the parties is signed.

Responsibilities of the parties should be:

- Independent from the mediator,
- For the mediation result, outcome,
- For the realization of the provisions of the agreement,
- For the real agreement or reconciliation.

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Responsibility in the process of mediation – in terms of pragmatic and ideological

Abstract

The article is a theoretical synthesis of mediator's tasks and obligations and parties taking part in mediation process in the context of responsibility for the whole process. It is also the analysis of law regulations referring to mediation. Issues of mediator's ethics, responsible realization of mediation rules, and responsibility for not taking actions or resignation by all the participants of mediation process were also raised in this article.

Key words: responsibility, mediation, justice, rules of mediation, ethics, judicial proceeding

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Cost characteristics of water resources of Ukraine in the measurement of the market economy

Introduction and literature review

Natural and resource potential is considered to be a powerful factor of development for each country in the world. One of the basic elements of the natural potential are water resources. All in all, taking into consideration the global warming, steep increasing of population and development rate, water resources are getting more and more valuable from the point of view of both society and ecosystem. According to the international experts' estimations, water is going to be a deficit ware of the same value as oil or gas in the nearest future.

In spite of their importance and uniqueness, water resources are not used rationally. As water resources are involved into economic circulation, they are affected by extraordinary anthropogenic factor, while the violations like pollution and excessive contamination of water resources have been ordinary phenomena of daily life. Surely, every government does its best to improve the state of water resources. The main ways of purification include technical equipments, when additional systems of purification are installed, and the industrial technologies are modernized with the view to reducing water consumption etc. Besides, the reaction to violation occurs mostly only after that violation took place, and results in redressing hardly the primary state of water.

Nowadays, there are good economic factors to influence the state of water resources. The financial motivation or financial limitations favorably affect the consumers of water resources. No doubt, changing of a consumer's behavior (population or enterprises) is subdued to financial factors. Financial factors are related to the possibilities of additional investments in this branch, because water resources have a significant (both real and hidden) potential to implement business projects. When necessary conditions, favorable environment and marketing environment are pre-arranged, water resources can be a very strong economic asset.

The success in implementation of these factors is closely related to indexes of real evaluation of water resources. When such evaluation is available, both the

opportunities of effective financial regulation in the branch and the opportunities of water resources involvement in financial and economic ambience are created actively.

Besides, currently, water and resources potential are being used for the development of finance and economy. Water resources are getting power to generate the market value. They are being smoothly included into various financial sectors' activities and defined by a significant potential of business processes.

There is a problem in Ukraine, which does not contribute to active positioning of water recourses within a financial and economical activities, which is low parameters of water resources evaluation. It results in a lot of investments being delayed because of a low level of cost justifying. The mentioned statement especially concerns the foreign investors, who need clear understanding of both water resources value within the area of their capital application and of single components of value.

Nowadays, there are scientific researches exposing the way of estimation of water resources. Basic positions, which give understanding of how the development of economy is going on, the value indexes and procedures of evaluation of water resources potential in our country in general, are presented in research works of many authors (Khvesyk, Zbaherska, 2000; Redkovskaya, 2007; Mandzyk, 2014). The special features of geographic evaluation are considered in research of Tsependa (2009). The problem is that these researches don't include marketing characteristics. Partially, the task is solved in the research of Levkovs'ka and Sunduk (2014), where the theoretical principles of costs evaluation along with marketing characteristics are formulated.

The world experience in the mentioned problem is also very important (*Water Resources Assessment. Guidelines for Review of National Capabilities*, 1997). Besides, we must admit that the experience of international organizations is quite difficult to adapt to Ukrainian realities due to significant irrelevance between available methodical approaches and a system of accumulating the information. To account the marketing characteristics, the further development of offered methods for the country and their adaptation to current marketing conditions are necessary. According to the said above, the objective of my article is to develop an approach on how to evaluate the costs of water resources for the state and for regions, as well as their real approbation.

The methodology of cost characteristics of water resources

The routine of water resources evaluation for regions foresees an outlaying of basic principles composing the foundation. The principles create the idea of how to evaluate, and what possible basic results will be obtained.

1) Water recourses costs are different in their origin, so it is necessary to unite them within single groups. Referred to it, the whole procedure of evaluation is supposed to be divided into groups according to physical, marketing and

auxiliary features. The first group includes value characteristics of economical activities, the second group includes the characteristics that are created for water resources in finance and economical relations (rent, ecological services), the third one are auxiliary features for water recourses (e.g. virtual water).

As for the first group, the evaluation of water resources, which are really available within a definite territory, is carried out. The case in question is evaluation of considered water objects: 1) surface waters – natural reservoirs (lakes), water flows (rivers, brooks), artificial water reservoirs (storage pools, ponds) and channels, as well as other water objects; 2) underground waters and streams. The evaluation should define price characteristics of water resources in their natural ambience, before they are involved into anthropogenic circulation (Fig. 1).

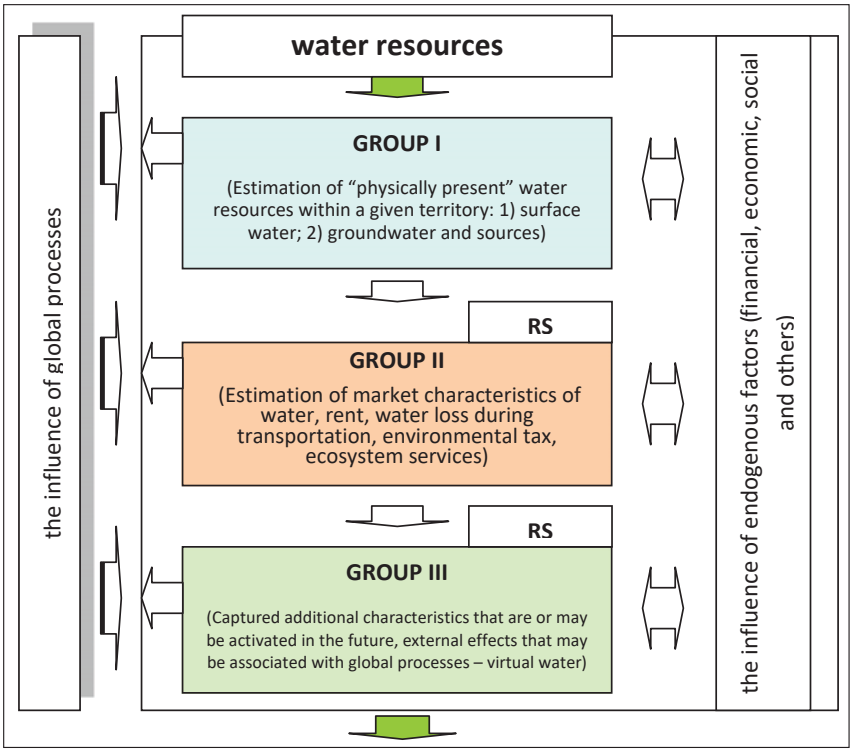

Fig. 1. Algorithm of cost estimate of water resources (– beginning of the movement for resource assessment procedure, ⇒ – one-way effect, ⇔ – two-way effect, RS – rising cost)

In the second group, the evaluation of marketing characteristics for water resources is created, that is, such features come about, when water resources begin their economic circulation, so, when they get their marketing characteristics based on their physical characteristics. When we take into consideration the latter ones, we can admit that they increase essentially the price of water resources. In many cases, a share of marketing characteristics of water resources in regional consideration can exceed their physical value.

The third group considers additional characteristics. As they are not immediately related to the characteristics of water resources, it is reasonable to consider them outside the water features. Exogenous factors (system of external effects and characteristics) are mostly related to particularities of water resources, depending on the state of the market. The saying goes about water resources evaluation in the global sense, when their price is increasing every year. The example of additional characteristics is virtual water. Based on the offered characteristics, the summary evaluation of water resources looks as follows: GROUP I + GROUP II + GROUP III = TOTAL PRICE OF WATER RESOURCES.

2) An important part of the analysis of water resources value is defining the indicators that are to be formed reasonably on the basis of system approach. Within this approach, the indicators should be divided according to the mentioned levels, e.g. physical characteristics – marketing characteristics – auxiliary (additional) characteristics. Each of these characteristics is explained through specific features, which in their turn are being formed according to sub-features.
3) The calculations are offered to evaluate the costs according to internal and world prices (keeping in mind the euro-integration priorities of our state). The similar approach lets us define the level of conformity for prices, as well as to make recommendations of their possible corrections for water consumption in the national scale. A distinctive feature of the calculations is an approach, when the value is calculated separately for internal and external (international) ambience.
4) It is necessary to notice that the value of water recourses is differentiated in regions. For single cases, the indicators of territorial differentiation are significant (Khvesyk, 2014).

Results of calculations

The calculations showed that water resources can generate a significant value. In internal prices, the indicator of their value accounts for about 68.8 bn hryvnas, in world prices – 78.1 bn U.S. dollars. The inequity between these values is huge and the main reason for this is the difference between prices for water recourses in Ukraine and the prices for water recourses in the world. Water recourses in Ukraine are underestimated a lot.

The physical characteristics contribute a great deal to the value. Their share in the national indicator of value is 69.2% according to internal prices, and 41.5% according to the world prices. Auxiliary characteristics play the least role in creation of national indicator of value.

There are significant variations in internal and world prices for different characteristics. As for physical characteristics, the internal prices mostly correspond to the world ones, for marketing and auxiliary characteristics – the correspondence between internal and world prices is not so good. Marketing characteristics have

the most differentiation in prices. It occurs because of the essential differentiation in payments for water resources consumption. The basic characteristic to create that differentiating was the indicator of ecologic services and its sub-indicators (Constanza, d'Arge, de Groot, Farberk, 1997). It shows that the ecologic services supplied by water resources of Ukraine (particularly the regulations of violations, regulations of water resources, water supplying, water purifying) don't correspond to the world price standards.

To illustrate sectors' features, let's analyze the indicators of rent and the characteristics of virtual water. The rent evaluations take into account the limitations of water resources. The costs for their development are averaged, that is why the economic evaluation is also more objective. Calculations showed that the financial flow generated by the rental mechanism can be defined at the point of 5.7 bn hryvnas in Ukrainian prices, and at the point of 4.8 bn U.S. dollars in world prices. The biggest financial characteristics are showed by industrial flows and irrigation. The main reason for such distribution in the first line are volumes of water that are the "area" to create the costs, as well as price characteristics of these water resources categories.

Virtual water considers the volumes of water resources, which were consumed for production of goods exported or imported between the countries (Allan, 1998). Under the condition of production moving, the migration of water resources also takes place within external trade, what in its turn results in redistribution of water potential significantly in the world scale. According to single scientific positions, taking into consideration the instruments of virtual water allows a state to balance the water characteristics.

Calculations indicated that the common export indicator for Ukraine was 19.5 bn m^3, which evaluated at the point of 8.5 bn hryvnas in internal prices, and 11.5 bn U.S. dollars in external prices. Export indicator is considered as the important one and says about an essential potential to create the virtual water within Ukraine. When compared to other indicators for water consumption, this indicator can be seen to exceed them significantly very often.

Considering the import characteristics, it is possible to declare that the virtual water values are not so essential and are limited by the point of 1.84 bn m^3, which is evaluated at the point of 5.5 bn hryvnas in internal prices, and 1.78 bn U.S. dollars in the world prices.

Therefore, the facts show that there is a significant misbalance between import and export volumes of virtual water, and this misbalance is 10 times. Let us make here the following conclusion – characteristics of external trade of Ukraine contribute to exceeding export of virtual water to abroad, what constitutes a menace to the national policy of water consumption.

It should be underlined that the costs of water resources are regionally differentiated. In single cases, the indicators of territorial differentiation are significant. The main reasons for forming these differences are the following: 1) Available

reserves of water resources (defined within their physical characteristics). Provided that region A has enough surface and underground waters, it affects considerably the indicators of physical characteristics, and therefore, the total indicator for the region; 2) Economical characteristics of the region. Providing the territory contains powerful industries, big cities concentrated within a region, it contributes to water resources being involved into economic activities. It results in affecting the evaluation characteristics; 3) Influence of additional processes. First and foremost, this is virtual water. Its major volumes are known to concentrate in exports and imports of cereals. Thus, the regions involved in majority of these operations will be affected mostly by these additional characteristics. An interesting feature outgoing from this research is a concentration of such characteristics for the city of Kyiv, the profile of which is not actually agrarian. However, it is its territory, where the head-offices of agrarian enterprises are concentrated. Nevertheless, the enterprises themselves corresponding to these offices are based in other regions.

To define the general features of value concentration, the regions of Ukraine were grouped into: the highest concentration (I), high (II), middle (III) and low (IV) value groups. The grouping allowed for differentiation of the territory of country in value generation, and for a long term, defining the leader and outsider regions according to their possibilities of implementing the investment projects, which were based on value indicator and on implementation of innovative instruments.

The grouping of regions shows that mostly the western and northern regions of Ukraine (including the capital) are of priority. Exactly those regions are often the territorial leaders in their defining of the values of water resources. Currently (as well as for a long term) they may become the areas of adaptation in order to implement the investment projects and use the innovative instruments for water resources.

Along with this, one of the challenges that can slow down the implementations like those is the fact that the value is formed by the physical characteristics for most cases (e.g. just by availability of water resources in the territory). It is necessary to enhance the influence of marketing and auxiliary characteristics, what would prove the active positioning of water resources in market relations.

Besides, a factor, which can slow down the marketing activities, is faint development of financial infrastructure for the majority of regions in group. For example, the implementation of financial instruments is quite a problem for Transcarpathian and Ivano-Frankivska regions. The capital and Kyiv region have better preconditions.

Summary

Making the conclusions, let's notice that the forming of costs for water resources is a rather complex activity and depends on a lot of factors. It was shown that both national and regional water resources are able to generate a significant value what creates favorable conditions for water resources being involved in

economic activities. In its turn, it activates implementation of investment projects and application of innovative instruments (rent, ecologic services, capitalization etc.) founded on costs characteristics of water resources. The costs characteristics of water resources were defined in internal and external prices, which are quite different.

What are the possible ways to implement the received results of economic evaluation for cost characteristics of water resources? Firstly, valuable characteristics of water resources can be used for elaborating the state strategies of development for water sector. Besides the conceptual principles of development, the strategic documents deal with financial characteristics, which may be generated in complex, and which are necessary for its steady functioning. Calculations of costs let us define both the national and the regional indexes.

Secondly, costs characteristics can become a basis for implementation of innovative instruments of financial and economical regulations.

The finance and economy need new resources that are fairly difficult to obtain with the conservative instruments. Using the principles of rent, payments for ecologic services, as well as involving water resources into capitalization – these are the instruments, which along with others demand the real reasoning of price characteristics of water resources.

Thirdly, the value parameters are the guideline for private investors. It was declared at the beginning of the article that its authors intended to strictly focus on potential profits based on the ability to generate value. The profits can be defined on the basis of both general and sectoral indicators of price.

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Cost characteristics of water resources of Ukraine in the measurement of the market economy

Abstract

The article investigates the positioning of water resources in systems of market economy. Water resources are considered as an important asset of the economic system. Formed methodical principle of procedure estimations of cost, on the basis of that research, base cost parameters of the state and regions for physical, market and additional features. According to the results, water resources of Ukraine can generate significant value, which differs considerably between domestic and world prices. Based on the cost characteristics of water resources it is possible for their inclusion in individual financial-economic processes (capitalization, rent formation, corporatisation etc.). Ways of integrating characteristics of water systems to the market economy are formed.

Key words: water resources, cost, market elevators, financial and economic processes

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FORMAL AND NON-FORMAL EDUCATION – NEW ENVIRONMENTS AND CONDITIONS

Tetyana Borova, Olga Demenko

Interactive learning environment as a powerful tool of students' personal learning responsibility upgrading

At present, the information revolution has led to the emergence of information society, whose next phase is knowledge society, where knowledge and information will be transformed into the most important factors of social development. Under conditions of information society formation, the content of education has changed to a considerable extent. One of the main factors of it is the informatization of the learning process, applying different media technologies. Mediation is a global process of the life and intellectual individuality space transformation via extension of informative and communicative field in the digital revolution era, implementing new media tools (the Internet, social network etc.). This tendency has influenced not only the educational process as a whole, but also its every participant, such as teachers, students and the learning process itself. This has led to a new paradigm emergence in education, as well as the evolution of new concepts in content development, and the emergence of a number of innovative methods to successfully render the information to the learners. Educators are constantly in search of more effective ways to engage their students in the process of learning, as well as increase students learning outcomes. This new learning environment will undoubtedly influence the way teachers teach and students learn. Taking into consideration rapid information society development, the use of modern teaching methods in higher educational establishments, particularly in teaching foreign languages, has become topical.

Noteworthy are the studies of the essence of interactive learning principles that have been furnished by such scholars as O. Pometun, I. Zimnya, N. Kuzmina, and especially foreign language teachers – S. Nikolaeva, N. Tuchina, D. Byrne, J. Harmer, A. Hopkins, M. Lewis, T. Woodward and others. The effectiveness of using information and communication technologies in the foreign languages teaching process has been studied in the works of O. Minkova, Ye. Polat and others. Despite a wide range of scientific papers, this problem remains scantily researched in terms

of interactive learning models usage for foreign languages teaching, proficiency of foreign languages teachers evaluating, specifically in modern context of e-society development.

The work covers the results of analyzing effective ways of students' individual responsibility development via introducing modern learning techniques into the educational environment.

The tasks of the work are to distinguish the features of interactive learning environment and techniques for students' individual responsibility development, foreign languages teaching under modern conditions of the information society development, taken as an example, to describe the results of such techniques implementation in teaching English to non-linguistic major higher school students.

Of importance in this context is the semantic analysis of the relevant core terms. To begin with the term "environment": accordingly, an environment is "external conditions or surroundings, esp. those in which people live or work" (Dictionary ABBYY Lingvo). Taking into consideration this definition, we regard an educational environment as the surroundings in which teachers and students co-work together, which tends to influence their development and behaviour. "Educational activity" then, is a "sphere of mutual relations between individuals from different social groups with the purpose of giving or taking an educational service" (Dictionary ABBYY Lingvo). Consequently, it is very important to make the educational environment innovative and self-organized, specializing that the environment is the surroundings, which influence the quality of relations between system's elements.

According to the Road Map of Educational Reforms in Ukraine (2015–2025), the main idea of the National Curriculum is individual students' development, upbringing such qualities as self-assurance, self-esteem, successfulness, self-realization of one's potential and one's life mission, initiative, cultural awareness, social activity, creativeness, self-motivation, individual responsibility, ability of human values orienting, ability of setting goals and fulfilling tasks, as well as managing one's life. In view of the above, the contents of educational environment should be revised. A new, emerged, pedagogical model should include a new learning style, embracing digital literacy, intercultural awareness, as well as individual responsibility for one's life upgrading.

We adhere to the definition of the notion "learning" given by S. Emmett: "Learning is the process by which you use your personal knowledge and experience to enable you to: make sense of things, by thinking; make things happen, by doing; bring about change, by moving from one position to another" (Emmett, 2008, p. 14). Thus, as it is highlighted by the concept "I think – I do – I move", it involves students' personal responsibility for one's learning results.

J. Harmer, one of the leading British methodologists put forward a triad "engage – study – activate", ensuring the success of learning/teaching of English (Harmer, 2007). We believe that the application of interactive techniques will definitely increase the efficiency of the learning/teaching process at all stages of the triad.

The following core term to be discussed is "interactive" (interaction – a mutual or reciprocal action or influence), and it means 1) allowing or relating to continuous two-way transfer of information between a user and the central point of a communication system, such as a computer or television; 2) (of two or more persons, forces etc.) acting upon or in close relation with each other; interacting (Dictionary ABBYY Lingvo). Thus, an interactive learning model is the learning process that is accomplished under conditions of continuous active mutual activity of all learning process participants (stakeholders). This model presupposes that students and teachers are partners. It creates some real-life situation simulations where joint responsibility for the learning results is in focus. There are a lot of interactive techniques that teachers can use in class. The most popular techniques are dilemma decision-making, case study, brainstorming, different role-plays, games, debates, different kinds of discussions and others, so any tasks that can simulate real life situations. In any simulation the situation may be contrived but, once in it, students have the freedom to respond as they think fit. This method brings about the real-life situation to make students react on the spot, requiring them to employ their ability to complete a task. As soon as the simulation begins, the students have to rely on their own communication and problem-solving skills. Effecting the task successfully brings a sense of true achievement and greatly boosts one's learning confidence. For example, with the students of our university (S. Kuznets Kharkiv National University of Economics) the most popular and effective simulations are a business meeting, various presentations, some games connected with business situations and debates on business topics. The students are by far more highly motivated and less stressed when involved in the activities that appear to be less difficult, yet are relevant to their own particular learning or future professional situations. Such activities mostly serve as useful practice in presenting an argument and expressing opinions, which is very importing for gaining the necessary skills that are very vital for students' personal responsibility upgrading.

We would like to stress that interactive techniques can be applied for all learners' intelligence types, stimulating personalization in class, either in individual or pair, group, distant instruction that modern educational framework can offer. Thus, the benefit of using information technologies in the interactive learning environment is obvious, being both real-life productive and motivating, particularly for learning foreign languages. The late emerged interactive learning environment on the basis of multimedia tools provides extra opportunities for teachers to implement a more effective complex of methods, based on modern didactic, pedagogic and psychological principles, as well as to make this process even more interesting, creative, learner-centered and friendly. Students also have more advantages while working in this environment: it opens up intellectual possibilities for individual style of learning and individual learning responsibility enhancement, giving more autonomy, making the student more creative, self-motivated. While acting in the environment the student gains the ability of setting goals and fulfilling tasks, as well

as managing one's life goals. Besides, information technologies can be used to take advantage of the fact that our brains access information in nonlinear ways.

It is generally acknowledged that one of the aims of learning foreign languages is to help students develop general and professional communicative language competences for effective communication in an academic and professional sphere. It is obvious that to become an effective communicator it is necessary to create certain real-life situations and in the interactive learning environment. In order to achieve this aim the students are to be involved in discussions and various problem-solving tasks. The best way to do it is to use the most powerful students learning tool – the computer, since e-learning is not only a modern technology, but also an integral part of students' life. Beyond doubt, today, the computer has become an effective learning tool. There are many pros and cons of using e-learning models in teaching English, in particular English for Specific Purposes (ESP). The main advantages of this model are the possibility of a direct/personal contact with a teacher via the Internet at any time, study at convenient time and place, have a self-assessment option, next to reduced costs of education and others. The disadvantages may comprise various issues related to computer-mediated communication in real life, both for students and teachers, in particular, English language teachers, issues related to creating an adequate content for e-learning, problems involving blended learning in the teaching process, shortage of time and facilities to implement e-learning techniques in classes and so on. But one thing is clear: the e-learning mode has become an inseparable part of modern education (Borova, 2013).

Experts highlight that students succeed in environments that provide multiple means of accessing information and knowledge, supported by content that is presented in multiple formats. Advances in multimedia technology provide students with new opportunities of using digital media to gain and share knowledge and work collaboratively on projects with their peers. These exchanges and experiences are rich, social, and often more meaningful than word-dominant classes (Borova, 2013).

Consequently, information technologies create "virtual reality" of real life environment, and allow to involve almost all students' feelings, which is a powerful motivating factor in developing students' personal learning responsibility for their learning outcomes. If a student has one's own responsibility for one's learning results it manifests one's personal responsibility. If a student is more responsible in class, he/she will, beyond doubt, become more responsible in real life.

Considering the above-mentioned, it is possible to highlight that the process of using multimedia in English classes betrays such core didactic principles as complexity, universality and interactivity that are central to learning English. Moreover, multimedia tools application brings about a personalized attitude to individuals, as well as task differentiation in ESP teaching, taking into account simplicity, availability and individual student's pace of learning. Implementing live channels, one can watch news, navigate the internet, watch different video materials, films, use multimedia programs in the process of learning, as well as read electronic books,

dictionaries, thus creating an active communicate environment to learn English. All these simulate conditions that reflect real-life situations in English, especially with the authentic language environment being absent.

It is fairly evident that no innovation can be efficiently introduced without highly qualified teachers who implement all the possibilities in the process of learning and teaching. The quality of knowledge provided by an educational establishment depends on the proficiency level of its staff. In our opinion, it is the professional development that brings to the fore the uniqueness and integrity of those individuals who seek self-improvement. Continuous self-improvement is the basis of professional activity of any English language teacher. It is common knowledge that the professional activity of English teachers is based on subject-subjective relations. A skilled, proficient, creative, socially active, humanistic value-oriented teacher is considered a true professional. The level of higher school teachers' proficiency depends on their competence, on the level of their professional-pedagogical thinking upgrading, as well as on their educational and research work standards (Borova, 2011).

We strongly believed that teachers' proficiency also should include a definite foreign culture awareness, raising-oriented takes that comprise a certain individual socializing, awareness-raising competence of the scientific and pedagogical worker, namely, one's socio-communicative competence, i.e. one's ability to efficiently create, a definite favourable socio-psychological interpersonal group climate, enhance mutually-supportive personal features of the personnel, both their moral, civic, as well as health maintenance competencies. Of essence on this context is one's ability and skill to be an efficient communicator, i.e. to be fully culturally aware of the emerging communicative tasks, as well as the required potential for self-development.

To fully analyze the dual process of learning responsibility upgrading on both sides: by teacher and students, it is necessary to determine the foundation conditions of the personalization-directed professional self-organization. This appears to be a three dimensional process. The first place is taken up by some economic conditions that substantiate the motivational sphere, providing the necessary system of material encouragement and rewards with a scientific and pedagogical worker individual rating to meet the posed objectives. The second dimension is a socio-professional one, the goal of which is to create an innovative educational environment, stipulating both one's vertical and horizontal career growth, while the third dimension specifies the development of scientific and pedagogical worker individual cultural awareness. Now, let us switch over to emphasizing peculiarities of the above-discussed dimensions. As was mentioned, the first dimension provides the necessary material incentives, helping a scientific and pedagogical worker to be motivated and effectively self-developed, it also substantiates an unbiased evaluation of the work of both a scientific and pedagogical worker and the department.

The second direction embraces basic professional necessities of a teacher. Creation of an innovative educational environment, that causes some changes in maintenance, methodologies, technologies of studies, permanently stipulating the

beginning of personal development in a particular professional sphere, brings about constant progress of the educational system and all its constituents. The satiation of the educational space provides access to the newest educational methodologies and technologies, both within the limits of an in-plant training (of seminars, trainings, consultations, conferences, classes' lectures cross-attendance, webinars and chats participation) (Borova, 2011).

The next important condition is one's inner realization of the necessity to self-develop, with a motivational aspect being of greatest essence in this case. It is worth noting that, at present, higher educational establishments strive to channel their ability to meet the employment requirements; in view of it, the professional needs of students have become a formative factor in the professional development of scientific and pedagogical personnel, as well as that of a higher educational institution itself.

The third direction embraces certain cultural development of personality of any teacher, which is an important condition of one's professional development under modern society conditions. Support on the part of leader in this context also plays a significant part. Organization of cultural events, stipulating scientific and pedagogical workers participating in some international events, in sum, intensifies the distribution of knowledge of scientific and pedagogical staff in the cross-cultural terms.

The introduction of the above-discussed interactive learning environment has appeared to be fairly fruitful, increasing implementing interactive learning environment has increased both students' learning outcomes and English teachers' professional development at S. Kuznets Kharkiv National University of Economics (S. Kuznets KhNUE). The term exam results at S. Kuznets KhNUE have revealed a 28% increase in students' ESP skills development level (years 1–4) due to constant implementation of interactive learning techniques and organizing an interactive foreign language surroundings for university students.

The administration and academic body of Simon Kuznets Kharkiv National University of Economics are fully aware that foreign language proficiency (especially that in English) is of great importance for modern experts in the field of economics, informatics, computer technologies and tourism. That is why in 2011 it was decided to give students an opportunity to participate in reading for and taking Business English Certificate (BEC) exam (administrated by the Cambridge English Language Assessment Department) at the university. This option has proved to be a more attractive one than others for S. Kuznets KhNUE students and staff. For the last five years, 253 students and 142 teachers of Economics received a BEC certificate. The university supports students' initiative to take BEC exam, since the grade obtained at the exam will be taken as an acceptable final mark in English, as well as the English state exam. This mark is also valid while going up to a postgraduate study. The worldwide recognition of Cambridge certificates ensures that the students who have successfully passed BEC exams are by far more likely to be enrolled for

the Master degree programs, administrated at both S. Kuznets KhNUE and abroad, with the training conducted in English, as well as to have access to education, employability and social mobility worldwide. Our university is a pioneer in preparing and taking BEC exams in Ukraine. It received a Gold Membership of Cambridge Exams Preparation Centers award in Ukraine from the Cambridge English Language Assessment Department.

Thus, the studies of several years' standing have proved that the informative technologies allow to successfully combine all methods of learning foreign languages, particularly interactive, that can simulate linguistic and communicative reality and improve speaking, listening, writing and reading skills of learners. These technologies help to realize the principles of integrated skills learning.

Thus, applying interactive learning environment in ESP classes is fairly more advantageous: this mode of learning is more promising than traditional modes, but still needs much deeper further analysis.

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Interactive learning environment as a powerful tool of students' personal learning responsibility upgrading

Abstract

The work covers the results of analyzing of effective ways of students' individual responsibility development via introducing modern learning techniques into the educational environment. It is distinguished the features of interactive learning environment and techniques for students' individual responsibility development, foreign languages teaching under modern conditions of the information society development, taken as an example. The results of such techniques implementation in teaching English to non-linguistic major higher school students are described.

Key words: individual responsibility, interactive learning techniques, educational environment, students' personal learning responsibility

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FOLIA 215

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Pedagogical conditions of training future managers for social interaction as a specific type of social responsibility

Introduction

Under the modern conditions, the society imposes new demands on social interaction between business organizations and itself. The joint efforts of businesses, government bodies and society are to solve the problems of social, economic and environmental spheres, such as: improving the quality of living standards by creating jobs; providing social security to employees; helping the poor, the disabled, orphans and the homeless; reducing environmental pollution; preserving cultural and historical heritage; developing social infrastructure and the like ones. The tool to regulate the social interaction between the society and businesses is social responsibility of all levels: individual, corporate (group), state and global.

Nevertheless, the Ukrainians show rather low motivation to responsibility, unreadiness to solve problems in any sphere of human activity, including professional or private, denial to take on responsibility in the decision-making. The main cause of such a situation is the crisis of values in the Ukrainian society due to the prevalence of the concept of "economic rights" over the concept of "social rights" and "socially responsible person", political instability, corruption, as well as the chase for quick profits without taking into account the consequences of economic activity.

Managers are the leading element in the social interaction "businesses–society". On the one hand, they bear the burden of social responsibility, on the other, they have to sacrifice their individual values to meet the requirements of their companies and company's owners and make professional decisions that conflict their personal ones. It may lead to "moral schizophrenia" (Bandura, 1997, p. 25; Goodpaster, 2007), because managers lack knowledge of social problems, skills of a decision--maker, and experience in this field.

The Ukrainian higher professional educational institutions still underestimate the impact of managers' attribute of social responsibility on their professional success and the outcomes of social interaction, as well as the welfare of the Ukrainian society. Consequently, future managers are not competent to cope with social problems and take on the role of a decision-maker within a business context.

Pedagogical conditions

The academic search results about this issue show that the concept of attribute of social responsibility is not unified. The modern concepts of social responsibility are the following: a specific type of social interaction that arises in the system of social relations and characterizes the person, his/her world-view, values, mode of existence; an internal individual attribute, complex social phenomenon which includes awareness of the need to act in accordance with social demands and social values, awareness of one's social role, self-critisism and permanent control of one's own actions, a willingness to be liable for one's deeds and socially important activities.

Lenk's construct of responsibility is six-component model asking: who (agent of responsibility) is attributed responsibility for what (object of responsibility), in view of whom (addressee) by whom (judging instance) in relation to what (normative) criteria and in what realm (of responsibility or action)? (Lenk, 1992).

Social responsibility is also referred to as a social interaction, it has the following components: the agent of social responsibility (individual, group, nation, humanity); the object of social responsibility is a part of the world with the agent interacts (social agent–object–agent relations in different spheres of human activity: political, economic, spiritual, cultural, environmental, educational, scientific and technological responsibility, responsibility in family and domestic relations); the subject of social responsibility is a particular object of some social relations (for example, the agent's activity is directed at individual or corporate responsibility in economic relations etc.).

Social responsibility as a social interaction in the business context is a mutual activity of at least two agents. The system-making center of any mutual activity are axiological dominants represented by the agents' common social or professional values. Hence, willingness and preparedness for a social interaction is determined by one's values affecting his/her world-view and cultivation of personal or professional attributes, the attribute of social responsibility as well.

According to Oyserman, values are internalized social representations or moral beliefs that people appeal to as the ultimate rationale for their actions (Merrill, 2009). Schwartz characterizes values as concepts or beliefs tied inextricably to emotions; motivational implications for a person's actions; abstracted goals that influence specific situations and actions; guidelines to evaluate the choice of one's behavior, actions, situations; values are ordered by relative importance and make up a system of an individual world-view and evaluative hierarchy (Rotter, 1966).

Scientists emphasize that the social responsibility of the individual, which affects his/her behavior should be considered in the particular context, because social responsibility is always connected with the existing norms or rules. It's the agent's choice whether to ignore, obey or violate them. Nevertheless, ignorance of the rules or norms does not exempt the agent of responsibility, so the agent is liable for his/her actions when violations have occurred, thus, the agent should be aware

of possible consequences of his/her actions and act upon the following scheme: "context–norm/rule–behavior".

We can assume that the attribute of social responsibility exercised by managers in any social interaction can be examined in the relationship: "context–norm/rule–value–behavior", where the context is the particular situation of professional manager's activity (for example, concluding contracts with a business partner to produce cheap but health-harmful packaging for baby foods); the rule/norm is a requirement under which the individual performs actions to achieve specific goals (e.g. maximize company's profits by using cheap but health-harmful packaging); the value is the desirable, trans-situational goal that serves as a guiding principle in one's life which directs one in his/her decisions, choices, and behavior, as well as regulate and modify relationships between individuals, organizations and societies in social interaction (e.g. Truth or Profit); behavior is verbal and non-verbal behavior of the agent of responsibility based on his/her awareness of the possible positive or negative effects of one's actions and responsibility to the society in the future (e.g. breach of the conract or other alternatives).

The essence of the social responsibility phenomenon is its duality and dialectical unity of contradictions. Currently, scientists distinguish two aspects of social responsibility, but because of the variability of approaches to the concept of "social responsibility" they do not adhere to a common terminology: voluntary––compulsory, personal–social, prospective–retrospective, and so on.

The voluntary aspect, in our opinion, demonstrates the agent's will activity and one's motivation for social interaction within the business context. The major modern concepts of the voluntary aspect of social responsibility are the following: the internal regulation of human behavior on stable rules of human coexistence, moral norms; personal inner sense of one's obligations and self-evaluation of their performance; individual reactions (system of responses) to the demands of the society; voluntary obligation to follow the requirements of social norms.

Voluntary social responsibility as a social interaction is primarily the result of individual spiritual development and determines the hierarchy of the individual values, through which social relations between agents of mutual activity become reciprocal and systemic. From philosophic standpoint, the core individual values are Truth, Goodness, Beauty. We assume that future managers should be oriented on Goodness as a core individual value, rather than focus on the corporate responsibility to regulate managers' social interactions, as future managers' professional success, social involvement and achievement are products, at least in part, of managers' professional self-concept. The orientation on the Goodness value will foster in students (future managers) such moral attributes as kindness, honesty, justice, tolerance, tactfulness, diligence, empathy, responsibility etc. Thus, future managers should be trained to solve problems, make decisions and act in difficult professional situations upon the following scheme: "context–norm/rule–the Goodness value––behavior/decision". We consider it as an algorithm of their future activity in the

situations of social interaction. One of pedagogical conditions is to train students to act upon the aforementioned scheme.

Compulsory social responsibility indicates the penalties, sanctions, restrictions etc., that the society imposes on the individual for his/her negative behavior in the past, for example: external regulation of human behavior that is retrospective in nature; social accountability and sanctions for actions that conflict the public interest; societal evaluation of individual actions and societal response to them; the public reaction to the actions of man; societal responses to the demands of the individual.

The discipline of psychology offers psychological dimensions to measure the concept of "responsibility" through the concept of "self-efficacy" and "locus of control".

Julian B. Rotter describes locus of control as the individual's beliefs in forces to whom he/she accredits his or her performance accomplishments or failures: internal locus of control is the individual's conviction that the event is contingent upon one's own behavior or his/her own relatively permanent characteristics. It means that a person has control over his or her successes and failures, and therefore is able to exert influence on his/her choices and environment; and external locus of control, which is the conviction that a person's decisions and actions are not entirely contingent upon his/her action, but under the control of powerful others or surrounding forces, such as luck, chance, fate (Oyserman, 2001).

Internal locus of control indicates that preparedness of future managers to control the situation and to make decisions is the basis for their professional self--concept. External locus of control indicates one's passive attitude to life, assurance that control over life depends on external factors. Thus, one of pedagogical conditions of training students (future managers) for social responsibility as a social interaction is cultivating in them the internal locus of control, as a criterion of the attribute of social responsibility and a self-assessment criterion of their professional self-concept (Oyserman, 2001).

Bandura conceptualized "self-efficacy" as "people's beliefs in their capabilities to mobilize the motivation, cognitive resources, and courses of action needed to exercise control over events in their lives". According to Bandura, self-efficacy has impact on the four major psychological processes of the agent of responsibility: the cognitive (construction and rehearsal of the anticipatory scenarios); motivational (goal-setting, steadfastness, failure resilience), affective (control of emotional or physiological reactions), and selection processes (the ability to handle difficult situations and to choose alternatives). Self-efficacy is dynamic as it changes over time with new information and experience due to four environmental factors: the agent's prior performance or his/her performance attainment; his/her observation of performance of others, social comparison and modeling others' behavior; social persuasion – verbal persuasion from a trusted other, especially, following a performance accomplishment; and physiological arousal, one's emotional state at the time of appraisal that affects one's confidence in his or her abilities (Bandura, 1997).

The aforementioned factors are, theoretically, universal and can be applied to every training task, therefore, they can be practiced in training future managers for social interaction. One of pedagogical conditions of training students – future managers – for social responsibility as a social interaction is problem-based learning. Merrill points out five phases of learning process: 1. Learners engage in solving real--life problems; 2. Existing knowledge is activated as a foundation for new knowledge; 3. New knowledge is demonstrated to the learner; 4. New knowledge is applied by the learner; 5. New knowledge is integrated in the learner's world (Lenk, Maring, 1993; Schwartz, 1992).

According to Merrill (2009), universal methods of instruction are based on problem-centeredness, activation, demonstration, application, and integration. The "first principles of instruction" facilitate learning and serve as criteria to evaluate students' progress appropriate to each principle: 1. The problem-centered principle demonstrates the degree of student's self-efficacy and locus of control in solving the problem; 2. The activation principle indicates student's level of relevant prior knowledge or experience; 3. The demonstration principle points out student's ability to compare alternative representations of the problem; 4. The application principle shows student's ability to self-management in applying newly acquired knowledge or skill to solve problems; 5. The integration principle demonstrates student's knowledge and awareness of a problem, his/her ability to handle the probable problems (Lenk, Maring, 1993).

Conclusions

Training future managers for a social interaction as social responsibility should be grounded on the following pedagogical conditions:

1. Students should be trained to act in difficult professional situations upon the following algorithm: "context–norm/rule–the Goodness value–behavior/ decision".
2. Cultivating in students the internal locus of control as a criterion of the attribute of social responsibility will provide them with a self-assessment criterion of their professional self-concept.
3. Training students – future managers – for social responsibility as a social interaction is problem-based learning. The criteria of selection of a problem for training students (future managers) for social interactions should be based on four environmental sources of self-efficacy.

The mini-research develops questions for further research of educational issues, such as student and teacher interaction, student's responsibility as a prerequisite for student's high or low achievement and formation of his/her own professional self-concept.

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Pedagogical conditions of training future managers for social interaction as a specific type of social responsibility

Abstract

The mini-research deals with the development of pedagogical conditions of training managers for social responsibility as one of managers' professional competence. The analysis of the scientific research in this field has shown that the term "social responsibility" is mostly conceptualized as an individual's sense of internal obligation to the society, but manager's social responsibility in business context is attributed by and to other people: company's owners, consumers, partners, personnel, the public authorities, other public institutions. The existing research has identified "social responsibility" as a specific type of social interaction, a manager's capacity to interact with other people and foresee the consequences of a social interaction, be liable for them.

Key words: pedagogical conditions, social responsibility, future managers, training

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Pedagogical design in the modern cross-cultural educational system

Introduction

We all live in an increasingly cross-cultural world. And it is natural that students' mobility in higher education is growing rapidly. The habitual way of engaging in global educational exchange has been through physical exchanges, such as cultural exchange delegations, semester abroad programs. And their importance can scarcely be overestimated. Nowadays for the Ukrainian students it has become the norm to face the range of problems which were rather extraordinary for the youth of the USSR epoch, such as how to be tolerant and curious of others, how to ask questions, how to listen, how to communicate to be clearly understood, how to promote, safeguard and realize the importance of the EU values within a globally influenced, culturally diverse and technologically advanced world. But it is becoming increasingly difficult to ignore that every foreign student coming to another country brings a variety of cultural influences, values and academic differences. Nevertheless, not every time we think over all the problems of choosing the right educational paradigm and patterns.

Over the years there have been many attempts to address these issues. However, far too little attention has been paid to pedagogical design problems within the framework of the certain educational paradigm. The aim of this paper was to compare educational paradigms in higher education across different cultures in order to clear the choice of the leading principles for pedagogical design to make it easier for students' to adapt to a new study environment. The main questions addressed in the paper are: to differentiate educational paradigms from the cultural point of view and depending on them to compare pedagogical discourse, as well as to highlight the range of pedagogical design questions of understanding how pedagogical solutions and technology could support exchange program students in diverse learning environments. Therefore, all the issues are explored intensively from the perspective of people who deal with those problems on a day-to-day basis.

Literature review

A considerable amount of literature has been published on the problem of cross--cultural education. However, many of the published studies describe the particular or special problems. The studies often fail to consider the differing education cultures, so long as students bring with them a long and different history of schooling of their home country, an experience, patterns of learning and study habits that have been formed in interaction with their cultural and educational environments.

In 2003 Wierstra et al. found that the patterns of learning, including approaches to learning, regulation strategies, conceptions of learning, and learning orientations, may coincide or conflict with the way of learning to be expected at universities abroad (4). In recent years, there has been an increasing amount of literature on regional approach to pedagogical patterns development. And it is significant for the countries of the post-Soviet space. For instance, we can easily find the marked differences in educational cultures between Western and Eastern parts of Ukraine as perceived by the Ukrainian students from these territories.

All the peculiarities should be considered and reflected in pedagogical design. While a variety of definitions of the term "pedagogical design" have been suggested, this paper will use the definition suggested by A. Romiszowski (1981) who saw it as any systematic choice and use of procedures, methods, prescriptions, and devices in order to bring about effective, efficient, and productive learning (p. 3). Conole's (2010) study found that the best academic courses and programs result from following a clearly designed process. The scientists consider a key principle of learning design to help in making the design process more explicit and shareable (Conole, 2010, p. 482).

Method of evaluation

A comparative cross-cultural analysis was performed on the basis of students of Kharkiv State Academy of Design and Arts, Ukraine. The research tools involved the following non-participant observations of the classes, interviews with five students from China, two students from Vietnam, five students from Russia, two students from Uzbekistan, as well as teachers from the USA. The non-participant observations provided the researcher with a comprehensive understanding of the context where the activities were being carried out, as well as the background knowledge to identify difficulties which may arise. The students' interviews showed how much they enjoyed the new learning environment and what is the great problem in the process of adaptation.

Results and discussion

The observations and the researcher's experience of dealing with international exchange students stress the importance to explore the blind spots within the countries' culture and higher educational system, i.e. the educational paradigms,

including approaches to learning, value orientations, pedagogical discourse, communicative strategies and patterns, testing strategies etc. Nowadays there are two definitely opposite cultural patterns, individualistic and collectivist ones, which predetermine the choice of pedagogical technology, forms of the academic information presentation, methods of organization of pedagogical mutual relations, and communication.

In Ukrainian pedagogical theory and practice during the last 20 years much more attention has been paid to development and implementation of a person-oriented education paradigm. But pedagogical design cannot be perfect without the knowledge of the values of the student audience, the habitual for them ways of the new academic material presentation and many other aspects which are rooted in the cultural peculiarities. In the paper we consider it necessary to present the results of the comparative analysis in the form of Table 1 to make them obvious.

Tab. 1. Comparative analysis of individualistic and collectivist cultural patterns

	Individualistic cultural pattern (the USA, the UK)	**Collectivist cultural pattern (China, Russia, Uzbekistan, Greece, Vietnam)**
Educational paradigm	A learner-centered educational paradigm with orientation on the best student	A teacher-centered educational paradigm with orientation on an ordinary skill level student
Teaching values (should be consistent, universal and transcultural)	Respect for a personal and human dignity; equality, freedom (freedom of choice and responsibility for it), creativity, individuality in self-expression	Usefulness for the powerful country, normativity (compliance with the established state standards), manageability (obedience), discipline, sameness
The main **pedagogical strategy**	Strategy of support and respect to each student	Strategy of active one-sided influence of a teacher into every student
The goals of the pedagogical approaches within the educational paradigm is to enable students	To develop both an understanding of scientific concepts and necessary critical skills in order to be able to express their own opinion or views: • broaden their perspectives, to motivate reflection on their process • criticism and feedback	To develop an understanding of the definite scientific concepts in order to be able to simulate the use of the obtained knowledge: • make their knowledge extensive and profound • retranslation of the learnt information
Pedagogical discourse	• The communicative type strategy presupposes first the ***statement*** as the single, specific claim that your ***information*** supports and then some arguments and examples. It is explained by the importance of a personal point of view with no matter what the recipients' opinion is • The discourse dominating idea is to formulate a personal position and opinion with performativity	• The communicative type strategy presupposes first the arguments and examples ***and then a statement***. The aim of this strategy is to prevent any disagreement or negative reaction • The discourse dominating idea is to keep up a friendly atmosphere and unity of views

Principals of testing and questioning	To check and measure the reached level of achievements with *the main goal* both to demonstrate positive experience and cleverness and to make the necessary improvements	To check and measure the reached level of skills and knowledge with (*as the main goal*) the following accentuating all the failures
The specificity of the use of the Internet information	Presentation of all e-materials in web 2.0 format that allows copying and editing of the content or "copy and paste"	Presentation of all e-materials in PDF (Portable Document Format), "canned" formats or "read only"
Design of learning space (classrooms)	Individual focused rather than group focused	Teacher-centric, that is poorly designed for collaboration and communication

All the mentioned should be taken into consideration at the designed education. For instance, Kharkiv State Academy of Design and Arts in Ukraine is a leading design and art institution of higher education located in Kharkiv, Ukraine, that offers undergraduate and postgraduate studies in Design and Fine Arts and post--master studies in design. The MFA degree programmes in pedagogical design equip students with cultural and pedagogical skills, so that the students can participate in and contribute to the expanding field of contemporary pedagogical design connected with the website design, design of learning environment, and e-books design, pedagogical design of the blended education. The programme relies both on students' lectures attendance and the independent studies, and all the students are provided with their own studio space. The professor-led group form the basis for collective discussions, presentations, lectures which take place in classrooms designed for single to many communicative styles by the teachers and students of the Academy. Additionally, the students may choose to take part in practice--based design research projects run by the Academy. Autonomous studio practice is bolstered by tutorials, critical studies and course electives, as well as excellent workshops including collaboration with schools and real-life problems.

It is essential that according to the cultural staff of the academic audience and the course goals the very classroom interior is changing. So, the tables are put depending on the form of co-operation with the teacher in each class. The updated type of pedagogical interaction organization necessitates the rejection of the usual arrangement of desks in a row. Cooperation of teachers with designers seeks to develop new types of learning space zoning (classes and classrooms), and is not centered on location of work-places in the "Z or L forms". According to Fielding learning process of the future should be distributed as follows "1/3 of all time devoted to work at a computer, 1/3 – to the academic communication, 1/3 – to independent work". Also Bigler offers a "studio model" of studio zoning (2) that provides dynamic changes in the forms and methods of implementation of the learner-centered educational paradigm. The timeliness of such projects is proved by the great demand, for example, a number of international design contests that took place annually (2000–2014) in Italy and Poland, the students of Kharkiv State

Academy of Design and Fine Arts are constantly receiving Grand Prizes for the design project of classrooms and auditoriums under the theme "Education in the future".

Conclusions

Although the experience of studying abroad may be enriching in many respects, adaptation to a new study environment is not always easy. Teaching and learning spaces must be changed to reflect the educational paradigm shift we are seeing in the XXI century between learners and educator. And it is pedagogical design considering cultural educational peculiarities of the students that can create some highly intensive and efficient measures to solve the existing problems in the world educational system. Pedagogical design is surely faultless without the knowledge of the values of the student audience, the main pedagogical strategy, pedagogical discourse, communicative strategies, principals of testing and questioning, the specificity of the use of the Internet information, design of learning space (classrooms). Pedagogical design based on the principles considering cultural educational paradigm peculiarities can also create some highly intensive and efficient measures both to solve the EU educational system problems and to speed up the integration of Ukrainian higher education into European "knowledge society". This research has thrown up many questions in need for further investigation.

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Pedagogical design in the modern cross-cultural educational system

Abstract

The aim of this paper was to compare educational paradigms in higher education across different cultures in order to clear the choice of the leading principles for pedagogical design to make easier students' adaptation to a new study environment. The main questions addressed in the paper are: to differentiate educational paradigms from the cultural point of view and depending on them to compare pedagogical discourse, and to highlight the range of pedagogical design questions of understanding how pedagogical solutions and technology could support exchange program students in diverse learning environments. Therefore, all the issues are explored intensively from the perspective of the people who deal with those

problems on a day-to-day basis. Although the experience of studying abroad may be enriching in many respects, adaptation to a new study environment is not always easy. Pedagogical design cannot be perfect without the knowledge of the values of the student audience, the habitual for it way of the new academic material presentation, and many other aspects which are rooted in the cultural peculiarities.

Key words: educational paradigms, learning environment, pedagogical design, cultural peculiarities

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Electronic textbooks in natural science education – research, development and practical use at schools

Introduction

One of the strategic objectives of the information policy is certainly the adaptation to the needs of the information society of the 21st century. The challenge for the area of education is to secure adequate information literacy within the frame of secondary education. It is needed in the context of this long-term goal of education to build necessary information infrastructure of education and ensure the integration of information and communication technologies into all parts of the educational process.

The main objectives embodied in the documents of the Ministry of Education in the area of information and communication technologies are:

- Each elementary and secondary school should be equipped with at least one multimedia computer connected to the Internet which would be freely accessible to the pupils and teachers.
- Assign the coordinator of ICT in schools.
- Equip each secondary and larger elementary school with at least eight computers connected to local network.
- Full integration of ICT into the educational process at all school levels.

The majority of primary and secondary schools have modernized and well--equipped classrooms nowadays, especially for the computing and informatics. However, the use of information technologies only slowly promotes in other subjects of the curriculum. In this context it also offers the implementation of new alternative forms of education in schools (e-learning, electronic textbooks and other electronic gadgets, project teaching).

New technologies in education contribute to the elimination of often stereotype, mechanical work of teachers, and create preconditions for the creative and students' motivating activities (Lopušan, Ligas, 1997). The implementation of information and communication technologies (ICT) in education also leads to the change in the role of the teacher. It can be found labelled in the specialized literature as manager, facilitator, actor, director, designer, project manager (Loveless, DeVoogd, Bohlin,

2001). This transformation can take one of two basic forms – the teacher performs in the relation to the pupils as a mediator or as a partner (Šeďová, Zounek, 2009).

Multimedia approach to teaching includes the use of several media components such as graphics, animation, audio, text and video simultaneously. The user gets information by multisensory experience driven by its own decisions using both static and dynamic components. The clearness just as motivation of pupils is supported in the full extend. Researches show that 87% of information we receive by vision, 9% by hearing, 4% by other senses. It has been proven that a person remembers 10% of what he read, 20% of what he heard, 30% of what he saw, 50% of what he heard and saw, 70% of what he said and 90% of what he did himself. This indicates that we must provide students with visual and audio-visual materials as much as possible and give them the opportunity to fulfil themselves (Petty, 1996).

The term "multi" can be found in dictionaries and encyclopaedias as a word meaning a multiplicity or many. The word "media" is often associated with the word "resource", "environment", "environment intermediate" or "intermediate entity" (Pejsar, 2003). In the modern sense multimedia is defined as the integration of text, graphics, audio, animation and video in order to convey information (Sokolowsky, Šedivá, 1994). The term "multimedia" has become the slogan of the 90s in the field of electronic data processing. The concept of what is covered by this term differs. Most of the time this term is considered as the use of various media to make convey of information by computer more effective (Sokolowsky, Šedivá, 1994).

Multimedia is one of the most effective forms of communication, search of information and the presentation of new concepts and knowledge, because it combines together all types of media. Good multimedia title can provide a better experience than the individual media separately, because it may include movies, books and magazines which can include pictures, animations, videos, audio and text.

Furthermore, multimedia has one crucial characteristic in addition: interactivity. It means that it is not passive, but allows mutual contact and is susceptible to our reactions (Fazekašová, 2003).

Multimedia in science education

In the natural science education multimedia applications are incorporated into the education with the goal of making mastering of a subject matter more effective and improving the educational process. The lesson is not only a simple interpretation of the teacher, but it is a cooperative activity of the teacher and the pupils using a variety of teaching methods, using specific didactic resources.

Multimedia in the natural science education can convey the information which is more challenging for adoption for students. They can better visualize the abstract concepts they hear for the first time. It also serves as a motivation aspect of the lesson. The natural science lessons can include video projections, computer presentations etc.

The elements of multimedia applications can be incorporated to encounter teacher's explanation (images, diagrams etc.) in the natural science lessons. In the case of insufficient equipment of the biology classroom or laboratory, or at absence of natural biological/geological materials, it is possible to use multimedia to demonstrate the simulation of given experiments to the students. Another way to use multimedia software is to provide it to the students for self-learning.

The advantages of using modern ICT in teaching of the general education subjects

Creative work based on computer technology develops mind of the student who always has to think about how he will accomplish his plan and how he will achieve his concept. If he fails, he must think about what went wrong and why it did not happen the way he expected and wanted. The computer facilitates inductive and deductive approach of creating knowledge and along with computer modelling and data processing it offers combination of these procedures.

Computers help to reduce the risk of failure in school, fear of our own shortcomings and failures. Motivation and focus on learning is the key factor for the acquisition of basic skills and confidence building of the student. Some students who still did not show any significant talent, show up as more successful at the work with computers than their coevals. The work with computers has influence on strengthening their self-esteem. Students with little motivation from classical ways of work in school may be inspired by the education with computers, which contributes to strengthening of the confidence by success.

Working with a computer can make a positive contribution to solving learning problems with students with mild brain dysfunction (especially dyslexia and dysgraphia). For these the computer can help to overcome problems associated with learning and gives them the opportunity to at least temporarily get rid of stress which they are constantly exposed to in school. It also creates better conditions for establishing feedback and more effective communication between teachers and students with learning disabilities.

The multimedia application of the curriculum allows to shorten the time dedicated to the study of a concrete topic. It also increases the proportion of self-study associated with active acquisition of knowledge and creates space for a differentiated approach to the pupils with the emphasis to respect individual pace of each student.

Another equally important aspect is the formation of the student's personality in terms of influencing independence, curiosity, systematic work and logical thinking.

The results of the research about the multimedia presentation of the biological curriculum in primary and secondary schools

The research carried out in 2014 in the Czech Republic primary and secondary schools has been aimed at the understanding of how the information technology is used in the natural science education. It has been focused mainly to find the conditions of multimedia presentation of the biology curriculum and the usage of multimedia software in education. The need of processing of electronic textbooks has been also followed.

We have used a specific method of educational research – questionnaires. The questionnaires included structured (closed-ended) and unstructured (open-ended) questions and combined items as well. Also scaled questions have been used to describe and highlight all the essential aspects.

At the end of the questionnaire there was a place for further suggestions and comments on the current state of the use of multimedia software in schools and for stands on electronic textbooks. Individual items tried to find the respondent's school type, if the multimedia software is used during the education, and if it corresponds with the content of curriculum given by curricular documents. Questions have also been posed focused to in which didactic phase of the lesson and for what purpose does the respondent use the software. Other items watched the spectrum of multimedia software used in the schools and were focused on their strengths and weaknesses or problems which arise during the usage of the software. At the end the questionnaire survey led to map the reasons which lead teachers to refuse support of computer education at each school subject, particularly in natural science and/or biology. On the other hand, as the teachers often create their own electronic materials for teaching (mainly in form of a PowerPoint presentation), space to show interest in electronic textbooks was also given in the questionnaire.

The structure of the respondents

Respondents were faculty teachers from the primary and secondary school, and other educators who collaborate in the implementation of education practice at the Charles University, Faculty of Science. They were not only teachers from Prague and Central Bohemia, but these information has also been provided by teachers from various regions of the Czech Republic. The evaluation of the survey included a total of 157 respondents.

Among the respondents of the questionnaire survey there was 19% of primary school teachers, 14% of four-year secondary school teachers, 27% of secondary school teachers and 41% of secondary technical school teachers (Figure 1).

Among the respondents there were 92% of science teachers and 8% of humanities teachers.

Most of the respondents was qualified (Figure 2) to teach natural history or biology (54%). From other science subjects, chemistry had most of the appearances

(35%), then mathematics (19%), ecology (14%), geography (14%) and physics (11%). 14% of respondents were teachers of specialized biological subjects, like florists, geology etc.

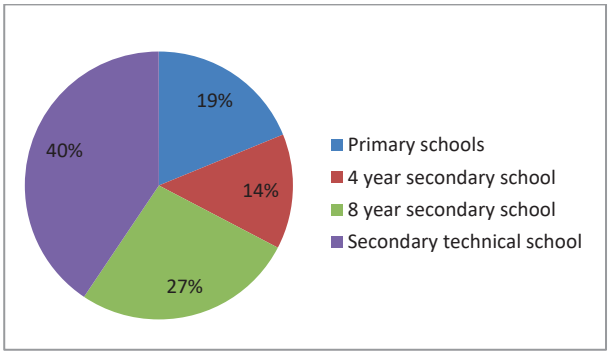

Fig. 1. Structure of the respondents (schools) in %

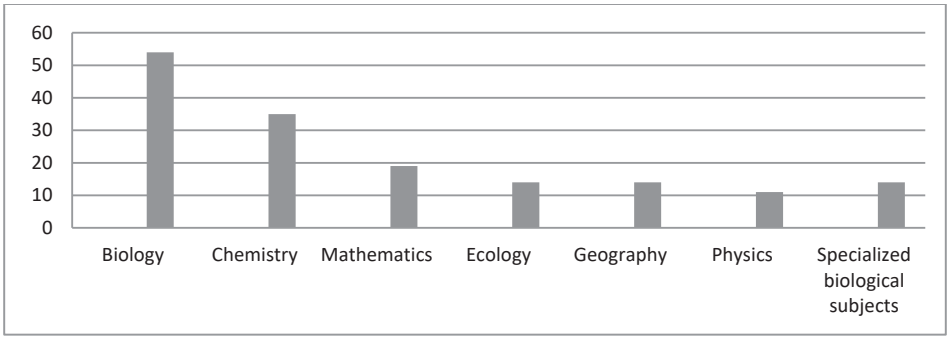

Fig. 2. Structure of the respondents (subjects) in %

Using multimedia applications in school teaching

46% of respondents said that multimedia educational software is used rarely in their classes. 27% of respondents use them very often, but the same part of respondents (27%) has never used multimedia educational software (Figure 3).

As many as 78% of respondents believe that it is needed to select only parts of the educational software due to the time restrictions. 41% of respondents are of the opinion that the content of available educational software has to be adjusted. Only 11% of respondents said that the content of available multimedia educational software completely corresponds with the subject matter in textbooks and curricular documents. In contrary, 1 respondent said that it does not correspond at all (see Figure 4 for summary).

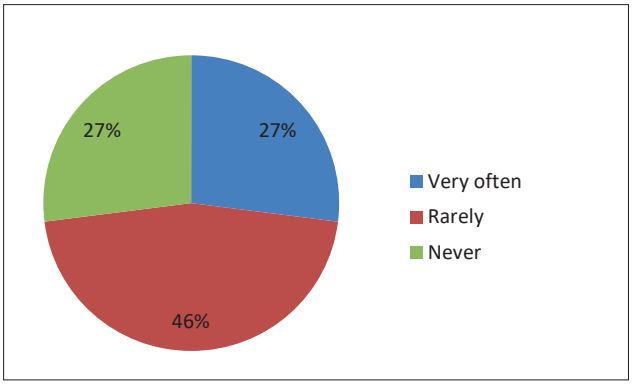

Fig. 3. Use of multimedia applications in school teaching in %

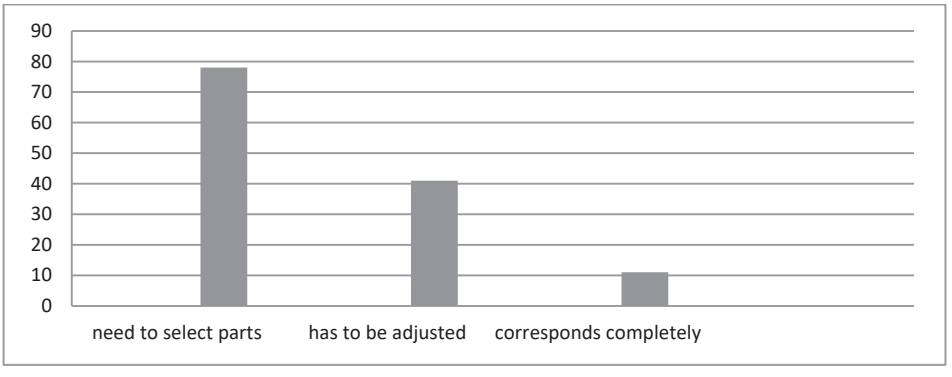

Fig. 4. Correspondence of multimedia educational software with curricular documents

Which topics or parts of biology seem to be suitable for use in multimedia software?

Botany and/or zoology have been proposed by 33% of respondents, human biology by 19%, and some themes of ecology and environmental protection by 13%. Additionally, 11% of respondents points to immunity or health education. A lot of opinions were presented but they don't occur more than in one questionnaire. 22% of respondents consider all topics without exception suitable for multimedia processing (Figure 5).

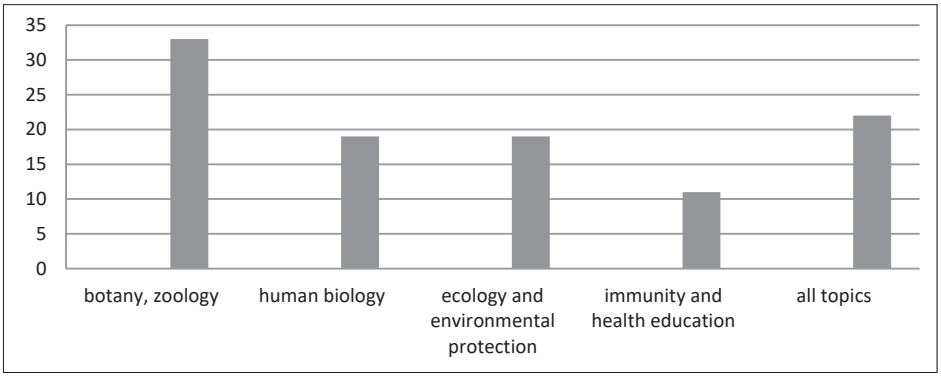

Fig. 5. Topics of biology suitable for use in multimedia software in %

Benefits of using multimedia software for teaching

89% of respondents agree that multimedia educational programs support clearness of the subject matter (Figure 6). Other responses were very diverse. More respondents agreed that multimedia educational programs are attractive (19%) and motivational (19%) for pupils. 15% of respondents see the advantages of multimedia educational programs in class enrichment, 15% see advantages in time savings in the teaching unit and making teachers work easier. Another 11% of respondents said that the multimedia educational programs facilitate more effective evaluation of students' knowledge.

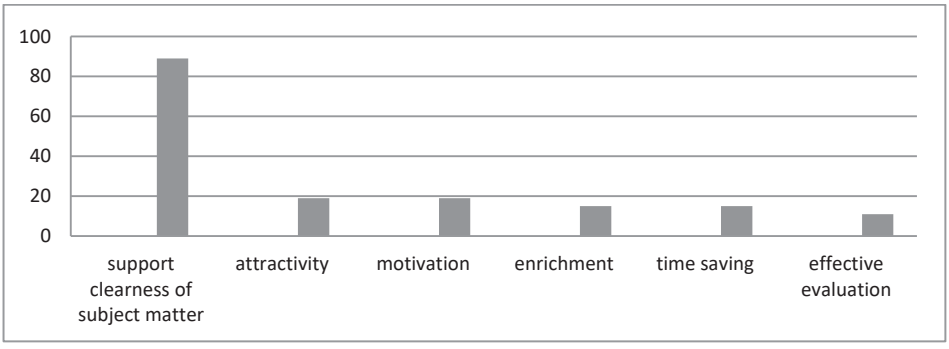

Fig. 6. Some benefits of using multimedia software for teaching

Other advantages of the multimedia are the support of the trend for individual work of students (38%), e.g. in the preparation of papers or individual verification and repetition, and also use to diversify, expand, complement and update the subject matter (38%). 13% of respondents see advantages in computer skills practice. Use of animations (25%) is also strongly appreciated.

When analysing the questionnaire research an interesting point of view occurred which emphasizes the advantage of multimedia cohesion with hypertext, pointing out that "this is the true biology".

Evaluation of deficiencies of multimedia software – what problems arise in its use?

The question focused to deficiencies of multimedia software has shown a large number of diverse responses. Among them (Figure 7) 22% of respondents identify price as a major disadvantage of educational multimedia software. 19% stated that the multimedia educational software does not correspond exactly with the content of subject matter, and therefore its use in teaching is rather time consuming. 15% consider preparing lessons using multimedia as too demanding. 11% of respondents point to the fact that educational programs contain a number of errors as their authors don't have any classroom experience, moreover, in their motivation rather finances are more important than the quality of teaching. Furthermore, difficulties were noted, related to the lack of appropriate educational technology, or to the low ability of teachers to use it for teaching.

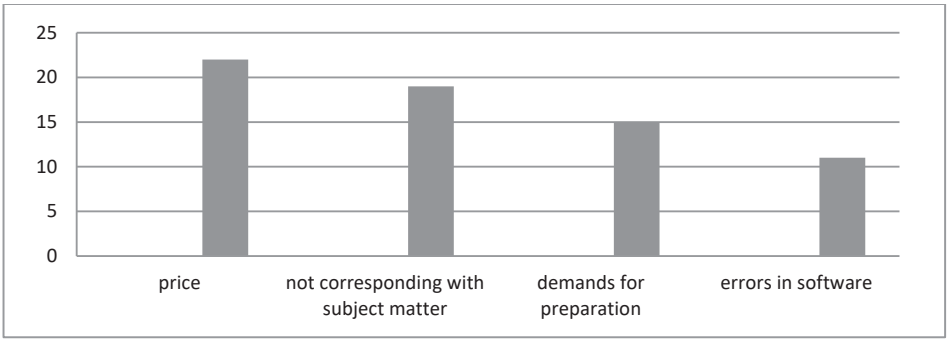

Fig. 7. Deficiencies of multimedia software in %

38% of respondents refer to spelling or technical errors caused by inaccurate translation into Czech language. They also lack a professional review of multimedia programs. Errors in the answers to the questions in tests were also noted. As a significant lack of multimedia programs 38% of respondents considered the fact that they are time consuming as compared to the content and scope of subject matters in natural science and/or biology, as well as time allocation to these subjects. Some respondents (13%) believe that multimedia programs can be effectively used in a small group of students, however, in school praxis commonly classes are not split into two groups in the natural science subjects.

Why is multimedia not used in schools?

For 39% of respondents multimedia software is not available in their schools. 32% of respondents see the reason in lack of time in the class. 11% of respondents don't have necessary hardware in the school and the same number of respondents believe that the reason is in the discrepancy between the educational content of programs and the subject matter (Figure 8). Answering this question, 39% of respondents didn't choose any of possible alternatives. Most of respondents also didn't use the possibility of free answer.

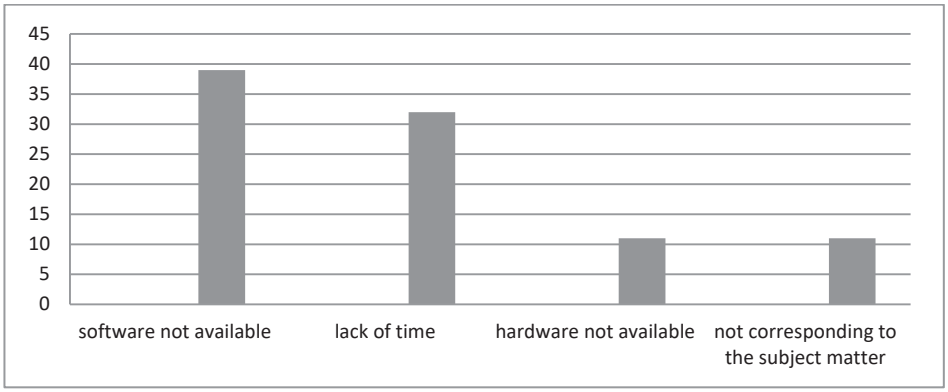

Fig. 8. Why is multimedia not used in schools? (in %)

Summary of the results

Results confirm that a methodical basis is needed for the use of multimedia applications in teaching natural history and biology. Another related research showed that teachers more often replace multimedia education software by creating their own multimedia aids focused to the specific lessons. This observation is supported by the fact that as much as 78% of respondents believe that it is necessary to select only some parts of a multimedia educational program for use in a lesson, because of time saving. 89% of teachers perceive the greatest advantage of multimedia educational programs in support of clarity of the subject matter.

Electronic textbook of biology for the secondary schools

Following the results of the survey mentioned above, in 2014 processing of electronic textbooks on natural sciences has been started (Figure 9). Electronic textbook of biology and geology was created in 2015 as an output of the ESF project aimed at promoting science and technology education in the Olomouc region. Teachers of secondary schools have been the authors of this electronic material.

Biology textbook for secondary schools was created in 2015 as an output of the ESF project aimed at promoting science and technology education in the Olomouc

region. Teachers of secondary schools – technical, as well as grammar schools – have been the authors of the e-textbook.

Fig. 9. Introduction to database of electronic textbooks, https://eluc.kr-olomoucky.cz/

As an electronic textbook is considered a computer application that enables touch way to browse multimedia and interactive texts. Furthermore, such one connects traditional reading, listening, video and animation with interactive elements as hypertext links, interactive charts, simulations, internet resources and, in the best, with the social networks for learning. It is not just an e-book, but it allows the student to insert his own notes, share them with other participants in learning and get feedback. Equally important feature is also the flexibility and the ability to change the content, form and way of textbook use by student and teacher. Another advantage is the ability to search and process information outside of school, i.e. at home or in the field. In this way an electronic textbook encourages the student to develop his interest to discover.

Like a printed textbook, the electronic textbook consists of the course presentation (verbal and graphical), guidance tools and tools for the evaluation of the subject matter. From a technical point of view it is linked with the school's online learning environment. Schools can take advantage of volume licensing, as well as financial advantages. The textbook is platform independent, accessible from all major computing platforms (Windows, Apple iOS, Android). Another significant features are the possibility of cooperation and sharing (e.g. through educational social networks), fulltext search, annotations (it replaces the classic notebook) and connection with other online tools. Using portable devices students have access to an electronic textbook anywhere and at any time. Technical support for the use of electronic textbooks are also tablets, which were schools in the project feature. When using electronic textbooks, as well as other products, copyright laws must be strictly respected.

Textbook structure

Key topics correspond to the names of the individual thematic areas listed in the Framework Education Programme. The textbook uses a range of flexible elements

such as hyperlinks, images, videos. To motivate pupils, curiosities and suggestions for research activities are included. For the evaluation, tests with closed items and multiple choice answers are integrated. A part of the textbook is also dealing with inanimate nature (geological sciences) (Figure 10).

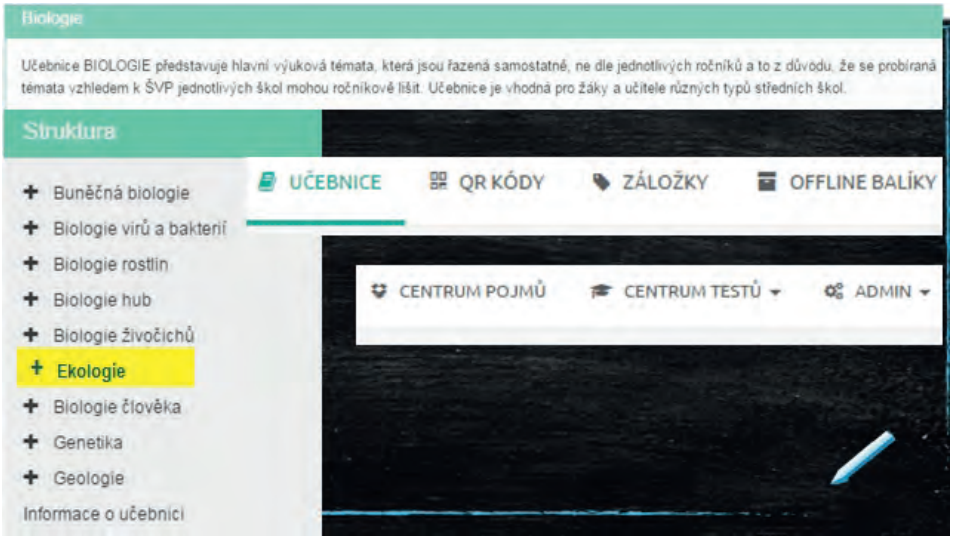

Fig. 10. Electronic textbook – title page

As an example of the processed topic ecology can be shown (Figure 11). There is the subject matter structured unconventionally and some topics are included, that seem to be up-to-date, but are not commonly found in textbooks. As examples, ecosystem management and genetic and ecosystem biodiversity can be mentioned. The topic "Ecosystem services" leads students to a new point of view on ecosystems, different of the common approach based on natural science only. It also points to the economic and social aspects of the functioning of ecosystem mainly in terms of sustainable development.

The role of ecosystems is evaluated not only in terms of science, but also services are shown that are provided by ecosystems to people. In the main of them are included: provisioning, regulating, supporting and cultural services. These interconnection aspects of natural and social sciences contribute to a paradigm shift in traditional perceptions of ecosystems. Through tablet, students can search and add other information on the topic (Figure 12).

Abiotic factors are compiled in a tabular overview with reference to subjects that give explanation to them in detail. Then biology is dealing with impacts on biota.

Fig. 11. Chapter on ecology shown on a tablet

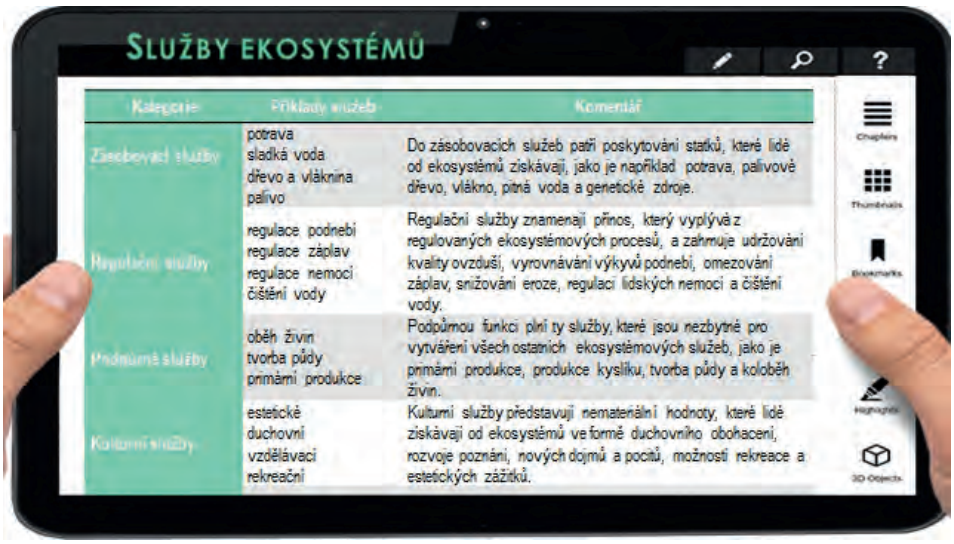

Fig. 12. Part of ecosystem services shown on a tablet

Conclusions

The teachers of natural science subjects perceive the greatest advantage of multimedia applications in support of clearness of the subject matter. Particularly positively they evaluate the use of animations of biological processes, which seems to be irreplaceable by other teaching methods. The multimedia programs, mainly electronic textbooks and textbooks' support, are qualitatively new approach to

learning, especially to active learning. The electronic textbook presented here is the first Czech biology (and geology) textbook for secondary schools that fully enables students to apply skills with modern technologies. Electronic textbooks meet the parameters of the texts of the new generation.

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Electronic textbooks in natural science education – research, development and practical use at schools

Abstract

The article focuses on specifics of electronic textbooks, their didactic parameters, selecting and structuring the curriculum. The creation of electronic textbook in biology (and geology) for secondary schools reflected the research made on grammar schools in the Czech Republic focused on use of ICT by natural science teachers in their lessons. The core of the research was the computer literacy and also the choice of subject convenient for electronic processing.

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Sensory preferences of dyslectic students and relevant teaching methods (the case of foreign language learning)

Dyslexia in foreign language learning – introduction

Dyslectic students face more challenges in learning a foreign language (or foreign languages) than their non-dyslectic peers. To learn how to effectively communicate in a foreign language, it is necessary to master its subsystems: the phonic (pronunciation, accent, intonation), the graphic (spelling and punctuation), the lexical (vocabulary) and the syntactic (grammatical structure). "To master these subsystems means to develop receptive, productive, interactive and mediatory skills" (Jurek, 2004, p. 98). However, it must be emphasized that "difficulties dyslectic persons face when learning their mother tongue tend to be multiplied in the case of foreign language learning" (Zawadzka-Bartnik, 2010, p. 218). Pursuant to research, foreign languages pose difficulties to ca. 2/3 of persons with dyslexia, of which 57% complain about the problems with learning vocabulary and grammar, 35% about problems with learning writing, 50% – speaking, and 57% – spelling (Zawadzka-Bartnik, 2010, pp. 220–221).

It has been emphasized both in literature and teaching practice that dyslectic students are in fact capable of mastering specific skills. Researchers (Giermakowska, 2009, pp. 223–231; Łockiewicz, Bogdanowicz, 2013) have pointed out to certain necessary conditions which should support foreign language learning. A key role among them is played by the organisation of the teaching process and teaching methods applied by the teacher.

Applied research methodology

Research objective: to identify sensorial preferences of a dyslectic student, to describe his difficulties in learning a foreign language together with his coping strategies, and to assess the adequacy of his techniques of foreign language learning.

In consequence, the research covers student's sensorial preferences and the resultant learning styles, along with strategies of coping with difficulties encountered in foreign language learning.

Research problems corresponding to the research objectives and objects can be verbalized in the form of the following research problems: what are the difficulties related to foreign language learning faced by the analysed student? How does he cope with those difficulties? What are the analysed student's preferences in foreign language learning? What is his self-assessment of the methods he uses? How do his teachers assess the effectiveness of those learning strategies?

Research methods and techniques applied were: specific case analysis, including an open pre-structured interview with the student and the academic teacher (language teacher), observation (during language lessons), outcome analysis (student's works).

Study subject: a dyslectic second year full-time student (academic year 2014/2015) at the University of Economics in Kraków diagnosed by a psychological and pedagogical counselling centre with dyslexia; teachers working with the student; 3 persons in total.

Difficulties in foreign language learning manifested by the analysed student

The analysed student graduated from a Kraków-based high school (*liceum*), and previously completed junior high school (*gimnazjum*) in one of the Kraków suburban communes. He was diagnosed with dyslexia as early as in primary school. The same learning difficulty was diagnosed in his older brother.

In the first three grades of the primary school, he participated in remedial classes, and was subsequently covered by a review diagnostic procedure, which enabled him to benefit from special examination terms in junior high school and when taking his high school leaving exam (*matura*). Pursuant to the information obtained on his learning achievements, the subject was never at threat of failing a subject, but from a very early stage he faced difficulties with reading and correct writing, and found it hard to learn foreign languages (English, German). He has consistently received better grades from sciences. Physics, mathematics and IT never posed any significant difficulties to him. The selection of the field of study was significantly motivated by his interests, but also the awareness of his own limitations.

Learning difficulties identified by the student included:

a) In early primary education: spelling errors caused by incorrect pronunciation (based on the information provided by the student, his speech impairment involved lisping, characterised by the incorrect pronunciation of lingual alveolar phonemes and their replacement with a number of dental sounds, resulting in incorrect spelling); spelling errors caused by difficulties in differentiating between similar phonemes; slow reading pace; numerous distortions of words; difficulties with understanding the content; reluctance towards tasks involving efficient reading and writing. The examined student has never experienced dysgraphic difficulties – the graphic level of his writing was never questioned by his teachers.

b) In grades 4–6 of the primary school: the reduction of errors resulting from speech impairment that was eliminated at the end of the second grade, persisting spelling errors which, based on the interview with the student, should be qualified as dyslectic auditory errors, orthographic errors, deteriorating graphic quality of writing (probably as a result of a slow pace of work with a text).
c) In junior high school and high school: the subject reported no significant difference in comparison to the previous stage, but emphasised the intensifying difficulties in mastering foreign languages (he continued to learn English and started learning German).
d) At university: persisting spelling mistakes (occurring in handwriting), difficulties with the organisation of learning, the lack of regular learning routine resulting in periods of intensified work during which the subject observed difficulties with understanding texts and problems with memorization, easy fatigue. The student also experienced specific difficulties when working with a text. They were manifested by imprecise understanding of spoken utterances and written texts, difficulties in identifying their main thought, selecting and analysing information, identifying the sender and addressee of a message and classifying the style of an utterance or a text. When making his own utterances or drafting a text, the student experienced difficulties both in speech and in writing. The student was mostly evading spontaneous responses to utterances and active participation in various situations. His linguistic responses were not always comprehensible or appropriate. When processing an utterance, understood as the transfer of a message from speech to writing, he had a clear tendency to persistently apply the rules of a written transfer.

It can be said that all the foregoing difficulties concerning the analysed aspects of learning result from shortcomings in the perceptual-motor development (as confirmed by the information disclosed in the documentation of the psychological and pedagogical counselling centre made available by the student) and decrease his ability to learn a foreign language. Additionally, educational failures decrease his motivation, fuelling fear and reluctance.

Although the student was diagnosed with dyslexia early on, the diagnosis did not contain any detailed information on the dyslexia type or student's preferred learning style. Probably the teachers, who did not have adequate knowledge, used standard teaching methods while working with him, and the individualization of didactic procedures in his case was scarce.

Currently the student is continuing his study of English, and in the second semester commenced a course in Russian. His mean grade, depending on semesters, varies from 3.2 to 4.0. There is a clear difference between better grades he receives from subjects in his field of study and specialty, and grades from foreign language courses. However, it must be emphasized that the student's efforts to learn languages are underpinned by strong and varied motivation. The student recognizes the

importance of communicative skills for personal and professional development. His expectations related to the participation in foreign language classes are very high. Usually, they are related to practical (professional) aspects – in his view, language skills boost one's position on the domestic labour market and enable one to search for work and find employment abroad – but also a sense of duty (language courses are obligatory). However, student's own words suggest also the presence of motivation underpinned by fear – most importantly, the fear of marginalization, decreased valuation and self-esteem if his foreign language skills diverge from the expected standard.

This conclusion is illustrated by the selected fragments of his utterances quoted below:

> "My difficulties concern predominantly foreign language learning. I have problems with understanding a text I am listening to, I make errors when I write, I have problems learning vocabulary", says the student. He goes on to say that "(...) for this reason I feel uncomfortable when communicating in a foreign language, and so I limit my contacts with foreigners and go abroad reluctantly". And: "I have the impression that I do not know how to learn", "I am focused on ensuring the correctness of spelling, I do not follow the plot", "I have serious problems correcting my own texts, including computer-typed ones", "I have difficulty forming longer texts and utterances, using appropriate terms and expressions", "I speak ungrammatically, I use polonisms".

Language teachers added limitations with mastering the alphabet (pertains to the Cyrillic script), misspelling letters, non-grammatical utterances, typically resulting from the interference with Polish. Other difficulties included slow pace of work with a text based on listening and note-taking, which results in a delay, for instance, in taking notes in the traditional form of linear records.

The table below details information in this area.

Tab. 1. Learning difficulties declared by the examined student

No	Difficulty	Occurring previously		Occurs now		Does not occur
		often	rarely	often	rarely	
I. Reading						
1.	Slow pace of reading	x		x		
2.	Reluctance towards reading	x		x		
3.	Difficulties in understanding content after single silent reading	x		x		
4.	Difficulties in understanding content after multiple silent readings	x			x	
5.	Difficulties in understanding content when reading aloud	x			x	
6.	Ordering, content selection					
7.	Lack of focus on the text, reading regress, getting lost in a text	x			x	
8.	Mistaking graphically similar words		x		x	

II. Writing						
1.	Orthographic errors	x			x	
2.	Other mistakes – non-orthographic, e.g. misspelled letters, words, word distortions	x		x		
3.	Mistakes when recording digits, numbers		x		x	
4.	Poor legibility of handwriting		x			
5.	Difficulties in drafting written texts	x		x		
6.	No self-correction skills	x		x		
7.	Erroneous form-filling		x			x
8.	Non-automated handwritten signature		x			x
III. Attention focus and memory						
1.	Easy fatigue	x		x		
2.	Short attention span, short work time	x		x		
3.	Problems with memorizing information	x		x		
4.	Problems with memorising dates, codes, passwords, numeric data	x			x	
IV. Temporal and spatial orientation						
1.	Mistaking dates, hours, places, circumstances	x			x	
2.	Poor time management – constant rush, delays		x		x	
3.	Impaired spatial orientation		x		x	
V. Spoken utterances/speech						
1.	Difficulties with speaking clearly and providing information	x		x		
2.	Losing plot, chaotic utterances	x		x		
3.	Difficulties in understanding longer utterances or utterances of untypical structure	x		x		
4.	Inappropriate speech rhythm, melody, speed, accent, fluency	x		x		
VI. Learning techniques						
1.	Difficulties in organising the learning process		x	x		
2.	The lack of regularity and discipline		x	x		
3.	Inability to plan one's own activities	x		x		
4.	Learning schemes		x	x		
5.	Difficulties in selection of appropriate learning techniques		x	x		
VII. Foreign language learning						
1.	Incorrect alphabet recording	x		x		
2.	Mistakes in naming alphabet letters	x		x		
3.	Difficulties in learning new vocabulary	x		x		
4.	Difficulties with correct spelling	x		x		
5.	Difficulties in learning grammar	x		x		
6.	No ease when speaking	x		x		
7.	No ease in writing		x	x		
8.	Difficulties in understanding reported speech		x	x		
9.	Difficulties in understanding a text being read		x		x	
10	Difficulties in reading aloud		x	x		

The analysis of the foregoing information suggests that in many instances the frequency of symptoms identified by the subject intensifies on subsequent educational stages. This pertains in particular to the difficulties with foreign language learning. The situation can be explained by improper learning habits and inadequate learning and teaching methods. Another important factor is the fact that the awareness of failures intensifies the sense of tension in communicative situations, leading to the lack of ease when speaking. Some of the mistakes made by the student (in his own view) are the consequence of stress and are motivated emotionally.

Sensory preferences of the examined student

The subject was unable to identify his learning style precisely. He realised what his preferences were in the course of this research only. A vast majority of his teachers and diagnosticians with whom he has had contacts over the years have also failed to determine his preferred cognitive learning styles, including language learning styles. In the teaching process, teachers applied the same, non--differentiated, uniform teaching methods and measures to the entire class. Pursuant to the student, also university teachers, including language teachers, do not take account of the specificity of dyslectic difficulties when organizing and planning the class, concluding that at the college level students' problems are their own private matter. This information has been confirmed by language teachers as well.

The analysed student prefers visual style (according to Linksman's classification – Linksman, 2005), which can be described in more detail as the visual-kinaesthetic--auditory style, with a preference for the right hemisphere (according to J. Dyrda's classification – Dyrda, 2003), The table below summarizes typical features of the learning process based on these preferences and subject's response in various situations.

Tab. 2. Typical features of student's behaviour

No.	Category	Information obtained
1.	Manner of speaking	Taciturn, secretive, sometimes whispers, does not like speaking in the presence of unknown people, reluctant to speak about himself, prefers to listen, and if he does speak out his mind, his contribution is usually valuable and to the point.
2.	Handwriting	His handwriting is rather neat; although it contains errors, it is mostly legible. However, his pace of work is slow. His notes are neat, others often borrow them; sometimes he adorns his texts with additional graphic elements.
3.	Eye contact	He maintains eye contact during the conversation, he follows the teacher during a lecture; he is perceptive, notices and pays attention to details, often silently observes his interlocutors.
4.	Physical contacts	He enjoys being close to other people, but does not like excessive manifestations of tenderness.

5.	Physical needs and skills	He likes space, is fit, trains volleyball, rides a bike, runs, is capable of significant physical effort, combines intellectual effort with movement.
6.	Attention	Focuses on one activity, has problems focusing attention on activities and tasks deprived of visual stimuli.
7.	Memory	Remembers recorded information, highlighted using colour or shape, uses various "memory triggers", e.g. colourful post-its, notices and remembers details, remembers faces, looks, colours, remembers sequences of movements.
8.	Manner of expressing feelings	Preferably non-verbally, shows joy by movement, is honest, does not hide his feelings, laughs aloud.
9.	Manner of work (task: to assemble a model)	Observes, tries to match the elements, analyses the scheme, does not read the instruction.
10.	Problematic behaviours	Sometimes he gets lost in his thoughs, is absent minded, gets offended, lacks grit, postpones tasks until the last moment, becomes irritable when someone takes too long explaining something to him, forgets instructions.
11.	Problematic behaviours of other people	Screaming, verbal assault and aggression, moral preening.

The VKA preference allows one to learn by observation, repeating activities, note-taking, developing schemes, models, graphic summaries, learn by doing, copying, experiencing, manipulating. In this model, the movement component is very prominent; it involves manipulating objects, being active (fidgeting while seated etc.). A person with the right hemisphere preference starts with organization, to proceed with the consolidation of content, emphasizes connections and dependencies, which facilitates the transfer of information to long-term memory (Plewka, Taraszkiewicz, 2010).

In foreign language learning, matching a written record with the right pronunciation is highly important. Learning may be aided by recording words and texts in various graphic constellations, often reinforced and diversified by the use of illustrations, colours, fonts.

The analysed student learns foreign languages based on textbooks mostly. Textbook structure is communication-oriented, focused on developing speaking skills and correct responses in various situations. Much less attention is paid to the comprehensive teaching of grammar or to translation exercises.

The learning strategy adopted and internalised by the student (understood as a combination of a learning style and organization of individual work) is characterized by the lack of regularity, task-based learning, occasional learning (e.g. before an exam, a test, during the exam session, additional for-grade tasks etc.), is accidental and unorganised. It should be added that this organisation of individual study process is typical for many students, and the analysed subject is not a unique case.

Evaluation of the effectiveness of the methods used in overcoming difficulties – student's and teachers' viewpoints

The analysed student claims that he has never examined the effectiveness of his learning methods or assessed whether they allow him to attain results commensurate with his potential. He asked for some time to carry out such an analysis, but was unable to perform it on his own. Most probably, this situation has its source in the homogeneity of the learning methods reinforced throughout the educational process and the lack of comparison to other methods. He concluded that his knowledge on this subject is intuitive, the selection of learning methods has always been accidental or he copied the methods used at school. It is typical of dyslectic persons to "get attached" to certain learning methods and experience fear of change in this respect.

Language teachers claim that the language teaching repository lacks methods used in work with dyslectic students only. One should conclude that they typically select methods they find valuable and effective, based on multiple reasons. The teaching method selection criteria listed by language teachers include:

- Teaching methods suggested in the textbook and exercise instructions,
- The scope of skills to be learnt,
- Language competence level of the group,
- Teacher's own preferences,
- Time of work – the duration of the teaching unit.

They do not include students' cognitive preferences, their limitations, talents or interests. Meanwhile, university-level teaching methodology offers a vast array of effective methods of teaching dyslectic students with specific sensory preferences.

Methods recommended as useful for students with preferences corresponding to the analysed student's model include a number of engaging techniques. The assessment carried out by the student highlights their weaknesses and strengths. The advantages of the methods listed by the student include: stress reduction, creating a friendly, safe atmosphere during the class, maximum student engagement, motivation to active participation, emotional involvement, reinforced memorization, introduction of relaxing elements, self-control and self-correction learning, fostering friendly peer feedback, good work organisation and improved time management. Critical comments concerning the use of engaging methods focus on difficulties with obtaining fast feedback from the teacher as to the correctness of an utterance or a solution. What is more, such methods may introduce the element of competition, distort discipline of group work and cause chaos. They are slightly infantile, unserious, ridiculous.

On the other hand, teachers are rather reluctant to diverge from the specific teaching path suggested by the textbook and the exercises prepared by the textbook authors.

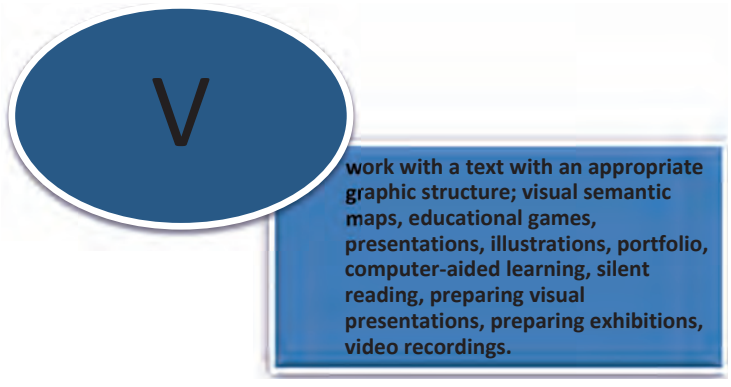

Fig. 1. Teaching methods useful for students with visual preference

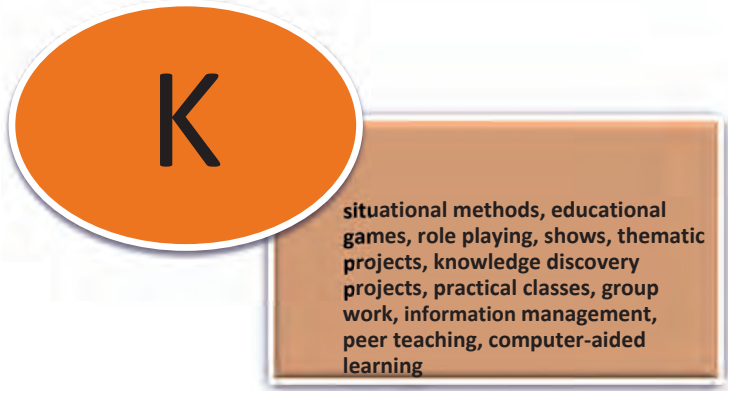

Fig. 2. Teaching methods useful for students with kinaesthetic preference

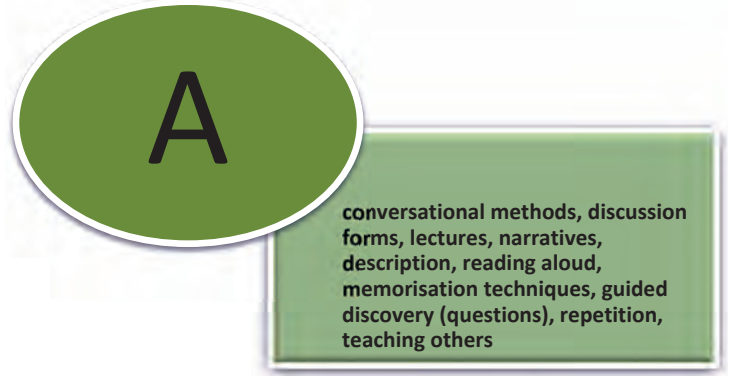

Fig. 3. Teaching methods useful for students with auditory preference

But it is not only the teaching methodology applied in the case of dyslectic students that determines the effectiveness of successful language learning. It is equally important for university as an institution to adopt relevant systemic solutions and ensure positive approach of academic teachers.

The analysed student is not demanding towards teachers or university as an institution. He speaks of his problems with dyslexia taking responsibility for solving them throughout the semester and during the exam session. This is a proof of his maturity, but also the lack of trust in the university. In the interviews, he has said that on previous educational stages he benefited from extensive educational support. In response to the question whether such a support system should be in place at universities as well, he concluded that such a system should be introduced, but its form should be different. He supported this view referring to the need to ensure the continuity of support, he cited experiences and practical solutions adopted in other states or, jokingly, listed famous dyslectic people who made their *alma maters* proud.

Interviewed language teachers confirmed that the university has no systemic solutions in place that would be targeted at recognizing educational needs of dyslectic students and analyzing possibilities of providing them with support. There is no "unit" that would assist this group in its efforts or support teachers in learning and gaining experience on teaching techniques that could be used with dyslectic students. These issues fall beyond the scope of the duties of the unit for the disabled persons, and no coordinator for dyslectic students exists in the university structure (unlike in the case of certain universities in Europe and the US). The study rules do not guarantee any individualized solutions for dyslectic students that could be applied throughout the semester and during exam sessions; such measures can be applied to a limited extent, depending on case-to-case decisions made by academic teachers.

According to the student, university teachers have little knowledge of what dyslexia is. "For them dyslexia is practically tantamount to low intelligence, or, to put it more bluntly, a dyslectic student is either dumb or lazy" ("Dyslexia, it means that you can't read?").

The modified foreign language learning strategy suggested for the student (the introduction of methods based on the visual and kinaesthetic channels, used as a "prop" for the weak auditory channel, systematic organisation of individual work with workload evenly distributed throughout the semester, ensuring that the student has the option to consult and obtain assistance in developing practice materials) has already brought about its first results. Student's emotional well--being clearly improved, along with his self-esteem. His test results are 10–15 points higher, which means the improvement of a 01.5 grade; in the case of the evaluation of speaking, the student speaks with more ease and with fewer grammatical errors. His vocabulary remains poor, language accent and melody are not always correct.

Conclusions, the discussion of results and practical implications

Pursuant to literature on the subject, the effectiveness of the learning process depends on a number of factors. They include student's potential and their cognitive preferences, as well as teaching methods. The aim of this research was to identify and describe difficulties faced by a dyslectic student (based on the assumption that his case is representative of a broader group with a similar potential, preferences and limitations), and present his coping strategies. What is more, the research included the educational background of the analysed student and foreign language teaching methods used by his teachers. When designing and planning this research, I was fully aware of the lack of knowledge in this field and the modest scope of studies carried out in this area in Poland and abroad. Although there are vast foreign and Polish resources describing the reasons and symptoms of dyslexia in the earliest stages of human development, educational problems faced by adults attract little attention. Meanwhile, lifelong learning has become an indispensible element of our life, and our global reality requires we master several foreign languages.

Dyslectic people have difficulty facing these challenges, while the effect of their work is often incommensurate with their efforts. What is more, it should be emphasized that dyslectic difficulties are permanent and should not be expected to disappear independently. Hence the need to modify and diversify teaching methods (including the methods used by – perhaps predominantly – foreign language teachers).

The research does not justify drawing any far-reaching conclusions. Rather, it identifies the problem and describes its nature. Despite the limited scale of the research, we can conclude that:

- The dyslectic student followed the obligatory educational path typical for general education. Dyslectic difficulties appeared relatively early and were diagnosed at the early stages of primary school. Initial and review diagnostics does not specify the cognitive style of the student or his learning strategies. One should mention the fact that such an examination does not make part of the standard diagnostic procedure performed during psychological-pedagogical examination. The student became aware of his learning style and hemisphere dominance when cooperating with the author of this paper. Among many difficulties that the student faced in primary school, junior, high school and at the university, he emphasized difficulties with foreign language learning – speaking, reading and writing.

  One should emphasize the fact that the co-existence of difficulties in reading, writing and speaking poses a different set of difficulties in foreign language learning than observed in the case of the native tongue.

  In this respect, research results coincide with those described in the literature (e.g. Bogdanowicz, Smoleń, Zawadzka-Bartnik).
- The examined student prefers the VKA style. Language teachers are unaware of his sensory preferences and do not apply a customized set of language teaching

methods. Although the student has passed his foreign language courses and exams, in his subjective view his language skills are low and insufficient to ensure comfortable communication.

This thesis is partially confirmed by research on learning styles in the context of cognitive requirements of school (e.g. Dyrda), but little space has been dedicated in literature to the analysis of the adjustment of foreign language learning and teaching methods to individual cognitive preferences.

- Of numerous teaching and language teaching methods, rather than focus on a specific group, one should concentrate on the combination based on the poli-sensory VAK rule (visual, auditory, kinaesthetic). The specificity of language learning (which includes learning vocabulary, lexical-grammatical structures and simultaneous coherent mastering of basic language skills, such as speaking, reading and writing) suggests the need to use both traditional and modern, engaging methods. They include: using textbooks, student books, exercise charts, source texts, dictionaries, translating software, silent reading and reading aloud, paper writing, spelling bees, memorisation techniques, role and scene playing, discussion forms, semantic maps, educational games, computer--aided learning. Another procedure that needs to be emphasized is the process of testing and assessing language competence throughout the semester and in the exam session.

  These aspects of research coincide with many studies on teaching (e.g. Okoń, Kupisiewicz, Jankowski, Przyszczypkowski, Skrzypczak), while the selection of the foreign language teaching methods based on the identified cognitive preferences has not been broadly discussed in the literature.
- One should conclude that the student's language learning is underpinned by strong and varied motivation. He recognizes the importance of communicative skills both in terms of personal and professional development. His expectations related to the participation in foreign language classes are very high. Usually, they are related to practical (professional) aspects – students are convinced that language skills boost one's position on the domestic labour market and enable one to search for work and find employment abroad – but also a sense of duty (language courses are obligatory). Additionally, fear-fuelled motivation has been identified – the fear of marginalisation, decreased evaluation and lower self-esteem. Such a high level of motivation involves expectations that the teachers will be effective, applying appropriate teaching methods and guiding students in finding optimum techniques for intellectual work.

University education differs significantly from education at lower levels. It is not only voluntary, but characterised by students' high awareness of their own potential, difficulties and priorities. Without doubt, these include language skills. Language skills are not a privilege, but a right. To attain this right, it is necessary to ensure that dyslectic students receive professional and friendly assistance of a language teacher, within the framework of systemic solutions. They comprise:

student's self-diagnosis that serves as a starting point for modifying their learning techniques, self-control and self-evaluation, and the measures adopted by university teachers, including the use of poli-modal methods, diversified tools of evaluation and control, and ensuring the possibility of obtaining individual assistance.

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Sensory preferences of dyslectic students and relevant teaching methods (the case of foreign language learning)

Abstract

The study contains a description of the dyslectic student's difficulties occurring in learning foreign languages, that overlap on the symptoms of dyslexia diagnosed in earlier stages of education. As an adult, the student trained a number of foreign language learning strategies and also how to cope with difficulties. The analysis carried out during the research indicates his sensory learning preferences and the used strategies (not always in line with the preferences). This is the basis for proposing changes in the organization of the learning process and student's work.

Key words: dyslexia in foreign languages learning, sensory preferences, teaching methods, multisensory teaching, learning strategy

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Contents

Introduction 3

SCIENCE, CULTURE, SOCIETY – NEW CONTENTS AND EDUCATIONAL CONTEXTS

Bożena Witek, Danuta Rochon-Szmejchel, Agnieszka Kamińska
What next for diabetes mellitus? 6

Daniela Kamińska, Jolanta Klusek, Justyna Klusek
Role of diet in primary prevention of colorectal cancer 20

Iwona Surowiec, Grażyna Świderska-Kołacz, Szymon Zmorzyński
Chronic lymphocytic leukemia –
clinical course, prognostic parameters, prognostic markers 31

Jolanta Klusek, Justyna Klusek
Phenomenon of ageing – a process or a state 42

Joanna Januszewska, Grażyna Świderska-Kołacz, Szymon Zmorzyński
Multiple myeloma – cancer among elderly people 52

Karolina Czerwiec, Marcin Purchałka
Functioning of a child with depression
in the school environment 62

POPULARIZATION OF KNOWLEDGE – NEW EDUCATIONAL
AND SOCIAL IMPLICATIONS

Emmanuella Di Scala, Nicolas Di Scala
Paradigmatic crisis and biomedical research 71

Bożena Witek, Danuta Rochon-Szmejchel, Peter Liedke
Addictive effects of alcohol 85

Iwona Maciejowska
Responsible Research and Innovation – how to develop RRI
awareness among young people? European projects proposals
and their results 98

Anna Michniewska
Secondary school students' perception related to
Responsible Research and Innovation 112

Katarzyna Potyrała, Karolina Czerwiec, Anna Ludwik, Anna Michniewska
Social media in communication and mediation of socio-scientific problems on the example of AIDS 120

Anna K. Duda
Responsibility in the process of mediation – in terms of pragmatic and ideological 130

Anatolii Sunduk
Cost characteristics of water resources of Ukraine in the measurement of the market economy 139

FORMAL AND NON-FORMAL EDUCATION – NEW ENVIRONMENTS AND CONDITIONS

Tetyana Borova, Olga Demenko
Interactive learning environment as a powerful tool of students' personal learning responsibility upgrading 147

Victoria Petrenko
Pedagogical conditions of training future managers for social interaction as a specific type of social responsibility 155

Olena Gonchar
Pedagogical design in the modern cross-cultural educational system 161

Milada Švecová, Ilona Horychová, Dobroslav Matějka
Electronic textbooks in natural science education – research, development and practical use at schools 167

Julia Klapa
Sensory preferences of dyslectic students and relevant teaching methods (the case of foreign language learning) 180