E-LEARNING: EDUCATION REGARDING CHEMICAL COMPOUNDS IN WASTE

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Abstract
Every year, the amount and composition of waste are growing. The increase of waste depended on demographic characteristics, settlement structure, a location of towns, villages, and employment opportunities seasons. The term waste means "a movable thing or a substance that its holder discards, want to dispose of or is in compliance with the act, it is obliged to discard it ". Waste has not only a negative influence on the environment but can also represent a permanent danger. Statutory legislation focused on waste must respond to emerging requirements in the whole society in the changing production and economic conditions, what reflects in education. This development requires new approaches in education to pupils of primary schools. The aim of the paper is to inform about e-learning course, which is located on the website of Constantine the Philosopher University in Nitra (Slovakia) on the portal "amos.ukf.sk". E-learning course is called „Modernization of Education and Interdisciplinary Approach in the Category Waste and Waste Management". This course is one of the partial outputs of the KEGA project no. 044UKF-4/2017 oriented on the area of waste and waste management. The e-learning course focuses primarily on the chemical nature of waste from the perspective of educational work and its application to practice. The course deals with the care of the environment and nature. It presents a way of preventing environmental problems when dealing with waste referring to specific chemical compounds. E-learning course is divided into six topics. One of the topics is called „E-learning: education regarding chemical compounds in waste” oriented on water component of the environment. The theme is oriented on knowledge of 11–16 years old pupils about waste and its chemical composition in water component of the environment. The topic includes online education, which analyses a situation with waste in water component of the environment, search for solutions and ways to improve the actual state of the environment. The e-learning course allows you to combine lectures in text form with PowerPoint presentations, graphics, schemas, test and supplementary materials (tests, checklists, polls, surveys). There are several ways to process and present the curriculum, from simple text presentation of the curriculum, through interactive tutorials to complex simulations of real situations. The main advantages are the simulation of individual situations related to the chemical composition of the waste collection that pollutes the environment. We try to apply new trends and methods into the e-learning course in the form of educational materials, which are base on analyses considering the individual level of pupils’ knowledge. E-learning is a kind of skill, that promotes a learning management system, a learning curriculum within the curriculum. It is one of the possibilities of using modern didactic tools in the process of education. Online courses are a new way to supply pupils with study materials.

Keywords: E-learning, education, environment, water, pupil, teacher, waste.

1 INTRODUCTION
The current trends point at the fact that environmental education and training are changing and have a new cognitive strategy. The educational system is aimed to develop the quality of learning [1]. Basic requirements for teaching environmental concepts are contained in the curriculum, in the input requirements for the quality of education [2]. Pupils encounter the term waste in the selected scientific subjects (chemistry, physics, geography, etc.) based on their characteristics, properties, composition, methods of separation, possibilities of further use as well as the impact on selected environmental components already at primary schools [3], [4], [5]. In the chemistry, as a school subject, the attention is paid to the proper treatment and disposal of waste that is more oriented towards the cognitive component [6]. This leads us to the fact that it is not sufficient for pupils to meet waste-related environmental issues only during school lessons. Lifelong learning in this field and, above all, its application to practice (waste reduction, separation, etc.) is essential [7].

Ongoing KEGA project no. 044UKF-4/2017 aimed to the area of interdisciplinary approach and implementation of modern trends in education within the waste and waste management category aims to expand and supplement knowledge in the field of chemical waste composition with new knowledge...
that pupils will be able to implement in their activities. It is in our interest to support science teachers, especially chemistry teachers, and to point out their interconnection to demonstrate the importance of these subjects in the choice of future pupils' professions.

The aim of the paper is to inform about the e-learning course, which is oriented towards the environmental care, to show how to prevent environmental problems in the treatment and disposal of waste depending on their chemical composition. The e-learning course is one of the partial outputs of the KEGA project (no. 044UKF-4/2017). The study material, which is included into the educational themes of the course, analyses the situations related to waste collection and looks for the solutions to improve the quality of the current environment. The e-learning course focuses primarily on the chemical nature of the waste from the perspective of educational work and its application into practice. It is designed for pupils (11-16 years old), in-service teachers and the pre-service chemistry teachers.

2 E-LEARNING EDUCATION WITH THE THEME OF „WASTE AND ITS CHEMICAL COMPOUNDS“

A rapid increase in the development of the Information and Communication Technologies (ICT) is part of a new era which is coming into the educational system [1], [8]. (The use of the e-learning is becoming widely accepted in formal and informal learning [9], [10], which shows that it has the potential to be used effectively in environmental education as well [11]. The e-learning is a kind of education that promotes a learning management system (LMS) within the curriculum [1]. The e-learning is one of the possibilities of using the modern didactic tools in the educational process. Online courses are a new way to address pupils and students with study materials [12]. Lifelong learning, adult learning and the increased use of Information and Communication Technologies (ICT) predetermine the important role of e-learning in the process of education [11], [13].

Chemistry as a scientific discipline is focused on the substances, their changes and conversion into other substances based on chemical reactions [6], [14], [15], [16]. It has a very close relationship with the environment [17], [18]. The main objective of the e-learning course is to deepen pupils' interest in the chemical composition of waste and the activity of waste management. Pupils are educated in chemistry at the lower secondary schools (7th-9th grades) and in the 1st-4th grades of 8-year grammar schools with its emphasis on scholastic and active character [19]. Its content is based on situations, phenomena and activities that have a chemical nature [20], [1]. This emphasis on scholastic and active character is very crucial for pupils and their relationship with chemistry. Chemistry is important for the life of every human being which is illustrated by the impact of chemicals on the environment (air, water, soil) [21], [17], [22]. It is necessary to use the knowledge gained from chemistry [23] mainly with regard to the observation of chemical composition of waste and its impact on the environment.

The issue of sustainable development and thus the reduction of the amount of waste concern the entire society as a social group, including pupils in all types of schools [24]. It is important to motivate pupils to contribute to the reduction of waste [2], [21], because a good motivation is the basis of every effort [25], [26]. The composition of waste is chemically diverse. The knowledge-based e-learning system identifies the cognitive level of the learner for better understanding of the content.

3 METHODOLOGY

The task of the e-learning course is not only to introduce the project and its objectives, but mainly aspiration to improve the educational process and at the same time to incorporate new development trends into the preparation of school-age youth, pre-service teachers and as a methodological tool for in-service teachers. During the ongoing KEGA project (No. 044UKF-4/2017), we prepared and organized the following activities: discussions, lectures, seminars with practical demonstrations and workshops about the environmental protection in relation to waste and its chemical composition for pupils, pedagogy students and in-service teachers. The knowledge and experience gained in this way helped us whilst the preparation and complementing the e-learning course entitled "Modernizing of Teaching and Interdisciplinary Approach within Waste category and Waste Management", which is currently in the final phase.

The e-learning course is based on the experimental research methods. The research methods (interview, questionnaire, didactic tests) were used in the preparatory phase of the course and they were oriented towards the pupils' knowledge about the waste and its chemical composition, towards the experience of teachers with the given topic and its understanding by pupils, and the possibilities of inclusion within the education:
• a survey in the form of questionnaire on a sample of primary school pupils and an 8-year study programme at grammar school participating in the KEGA project (No. 044UKF-4/2017);

• pupils’ opinions (in oral form) as well as pedagogy students after the end of the individual activities of the project;

• teachers’ opinions and experiences gained during the preparation and realisation of the individual activities.

The current research requires the use of more than one research method [27].

The main hypothesis was formulated based on the research problem:

Electronic education (e-learning education) focused on the chemical composition of waste affects the changes in pupils’ attitudes towards the Chemistry as a school subject.

The e-learning course, as a part of the project, to support the education about the chemical composition of waste is located on the Constantine Philosopher University (hence CPU) website in Nitra on the portal "amos.ukf.sk" in the LMS Moodle. The CPU in Nitra in LMS Moodle has created an electronic training portal to support the ongoing courses or already completed projects (Figure 1.).

![Figure 1. The E-learning course which is called „Modernization of Education and Interdisciplinary Approach in the Category Waste and Waste Management” is located on the website of the Constantine Philosopher University in Nitra (Slovakia) on the portal "amos.ukf.sk" in the LMS Moodle.](image)

The task of the e-learning course is to develop online learning based on the knowledge from the chemistry by incorporating the waste into the process of teaching science.

The e-learning course allows to combine the lectures (MS Word) with Power Point presentations, graphics, schemas, test and supplementary materials (tests, files, control questions, polls, surveys) [28]. There are several ways to process and present the curriculum, from the simple text presentation of the topic, through the interactive tutorials up to the complex simulations of real situations. The main advantages are the simulation of individual situations related to the chemical composition of the waste collection that pollutes the environment (air, water and soil). The chemical elements and chemical mixtures contained in the waste represent various dangers and risks that can threaten the quality of health not only for us but also for the environment [16] [17], [29]. The incorrect handling can cause unforeseen reaction or other harmful effect on human health [30] and the environment [21], [22]. The course deals with the health protection, the preservation of quality of life and above all the environmental protection and care. Within the category of waste, the pupils will discover the properties of substances, the patterns of their behaviour in nature and the interaction with the individual components of the environment (Figure 2.).
The main aim of e-learning is to offer a communication platform for the educational process. The main objectives of the project are also reflected in the topics of the e-learning course.

Each topic is divided into a theoretical and a practical part. The theoretical part is intended for in-service teachers, pre-service teachers and pupils of individual classes (7th - 9th graders, 1st-4th of 8-year studies at grammar school). The practical part consists of worksheets for pupils, questionnaires...
from the given topic and tests for pupils of individual grades. In order to communicate and to find out the opinions of teachers in practice, future teachers and pupils, the discussion forums, news, chats, questionnaires for given topics are created. Course participants have the opportunity to participate in the upcoming dictionary on selected topics. The prepared course was tested at cooperating schools and in selected classes.

4 SAMPLE OF “E-LEARNING: EDUCATION REGARDING CHEMICAL COMPOUNDS IN WASTE IN SELECTED ENVIRONMENTAL COMPONENTS”

Education and training in chemistry as a scientific subject are very important. Educational process focused on environmental components as water is significant because without water we could not exist. The topic of the e-learning course entitled “E-LEARNING: EDUCATION REGARDING CHEMICAL COMPOUNDS IN WASTE IN SELECTED ENVIRONMENTAL COMPONENTS” consists of the design and preparation of theoretical background (theoretical part) - teaching texts and methodological materials for in-service teachers. The primary objective of the theme in the e-learning course is to increase the level of knowledge of pupils in the selected area of the environmental component - water. The theme analyses water, its pollution, chemical reactions occurring in the aquatic environment and their effects on organisms. Pupils have to learn about the role of water in human life, water pollution and water flows and their consequences as well as the way of water protection. Special worksheets are created for pupils of selected classes (7th up to 9th grade of lower secondary school, 1st up to 4th grade of 8-year at grammar school). These worksheets deal with water and its importance for life and for nature. Achieving a high-quality educational process and, above all, using the knowledge gained in practice is only possible if the process is led by qualified teachers. Their role is not only to give pupils the necessary knowledge, but mainly to motivate pupils to learn to think creatively, act and behave in a way that protects the environment that surrounds them.

The theme of the e-learning course entitled "E-LEARNING: EDUCATION REGARDING CHEMICAL COMPOUNDS IN WASTE IN SELECTED ENVIRONMENTAL COMPONENTS" (Figure 3.) focusing on water as a component of the environment in a partial objectives deals with:

- a description of the basic concepts related to the environment;
- water characteristics, its properties (physical, chemical, physico-chemical);
- sources of water pollution;
- description of the origin and properties of pollutants in water and their impact on living organisms;
- changes caused by polluted water (surface water-flowing, standing, underground water);
- development and monitoring of pollutants in water;
- the selection of the content of teaching for chemistry as a school subject with water related topics according to the ISCED state education program;
- didactics of chemistry teaching with the given problems.

The environmental objectives of the theme are elaborated in worksheets for pupils of each year and are oriented to:

- clarification of forms of water pollution and pollutants;
- acquainting pupils with pollutants that may be present in water;
- characterizing the development and properties of pollutants in water;
- informing pupils about the impact of pollutants on the aquatic environment and the human body,
- understanding the importance of proper use of water resources;
- analysing global problems affected by polluted water;
- informing pupils about the current state and quality of watercourses in Slovakia;
- demonstration of the possibilities of nature protection and especially protection of water and watercourses;
- achieving an active and creative approach of pupils to nature and our water protection;
• to teach pupils to respect the values of nature and life.

The didactic goals elaborated in the e-learning course theme are:

• looking for connections between the content of the chosen theme and the theme of water, water resources and their importance for man;
• focus on environmental aspects depending on the individual classes (grades) and the age categories;
• water as solvent, preparation of solutions;
• selecting such motivational methods that will interest pupils;
• developing the reading literacy, supporting the reading and the reading methods and the work with the scientific text;
• independent acquisition of knowledge from different information sources;
• creation of projects on a given topic (collective work, group work);
• enhancing pupils' knowledge level with a new knowledge and information about water and water resources;
• deepening of knowledge and its subsequent application to everyday life;
• creating a positive relationship with the individual components of the environment;
• forming and developing pupils' logical, critical and creative thinking.

The quality of the teaching process depends on the careful and disquisitional preparation of the teacher. The objectives are needed to be implemented through the proper organization of work during the lesson and through the educational methods (motivational, exposure, fixation, diagnostic), while respecting the didactic principles (the principle of awareness and activity, the principle of clarity, the principle of proportionality, the principle of sustainability, the principle of consistency, the principle of individual approach to pupils, the principle of feedback in teaching, the principle of scientism, the principle of linking theory to practice).

The usage of worksheets in the teaching process can support pupils' interest in the state and the quality of water and water resources, can enhance their development and cognitive skills, and can also influence pupils' activities and creativity in protecting that environmental component. While completing worksheets, pupils work under the guidance of a teacher. The worksheets can be completed directly on the webpage of the e-learning course "Modernization of Teaching and Interdisciplinary Approach within the Waste and Waste Management category", which is in the LMS Moodle on the electronic project portal on the website of the CPU in Nitra on the portal "amos." ukf.sk in topic 2. "E-LEARNING: EDUCATION REGARDING CHEMICAL COMPOUNDS IN WASTE IN SELECTED ENVIRONMENTAL COMPONENT".

5 RESULTS

The use of information and communication technologies in schools is a common practice, whether as a teaching aid, a means of learning or in connection with the implementation of a technology-supported or managed learning process [31], [32]. The e-learning course which prepared as one of the outputs of the KEGA project is focused on the chemical composition of waste in the educational standard of the school subject chemistry for the pupils of the lower secondary schools and for pupils of the 1st up to 4th grade of 8 year studies of grammar schools.

The use of ICT during teaching chemistry is very promising. The e-learning allows education at any time and wherever while computer technology is the medium for this type of education [1], [28]. With the rapid development of technology, there is an increasing number of resources that appeal to gaining a new knowledge in the field of education [28] and thus to motivate pupils [25], [26], [33], [34]. Our goal is to prepare an e-learning course with such focused topics that will be interesting for pupils' at chemistry lessons and will motivate them to protect and care for the environment and thus for their health. We will try to ensure that the individual topics included in the course are close to the widest possible range of pupils and thus will contribute to climate change that accompanies the teaching of chemistry in a constructively-oriented spirit. So far, the positive pupils responses and their teachers during the activities (discussions, lectures, seminars with practical demonstrations and workshops on
environmental protection in relation to waste and their chemical composition) have convinced us that learning means to develop the basics of knowledge that have been already created.

The aim is to motivate pupils to focus on scientific subjects, especially on chemistry, to develop a positive perception of chemistry based on subject integration, to show pupils how important the knowledge of chemistry is due to the environmental protection via e-learning. The specific objective of the project is to point out the interdisciplinary nature and the interdependence of individual scientific subjects. We will follow up and strive to expand the active communication with pre-service teachers to give them more opportunities to improve their teaching knowledge and skills [35], [36]. We will look for the possibilities how to pass the teachers' experience from practice while raising the knowledge and shaping the positive relationship of pupils to scientific subjects. In order to update and modernize the acquired knowledge we will try to put gained facts into the upcoming topics of the course with the emphasis on waste, their chemical composition and waste related management strategies. The main task of the course is not only to introduce the project, its objectives, but also to improve the educational process and at the same time to incorporate new development trends into the preparation of school-age youth, future pedagogy graduates and teachers. These processes lead to high-quality education and conceptual understanding, as well as to increased personal growth and adaptation [33].

The interdisciplinary approach to waste related topics aims to lead our young generation to reduce the amount of waste and its separation based on composition and thus to the care and protection of the environment.

6 CONCLUSIONS

The current development of science and technology provides rapid opportunities for obtaining and accessing information and thus broadens the possibilities of the educational system. One of the solutions for obtaining new information and knowledge and increasing the effectiveness of education is the use of information and communication technology (ICT) resources. Our goal is to provide an e-learning course with interesting examples of educational materials and highlighting the link between chemistry and science. In the preparatory phase of the course we organized discussions, lectures, seminars with practical demonstrations and workshops focused on environmental protection related to waste and its chemical composition. Our attention was paid to obtaining information and interests of pupils, future teachers and teachers in practice. We have gained the inspiring experiences from organized activities resulting in actively process of the information based on pupils' positive internal motivation. The achieved results are the manifestations of internal motivation and internalization of values with a focus on environmental protection, using the available educational resources, especially the Internet to acquire new knowledge. We are convinced that increasing the quality of education via e-learning is a way for better communication with pupils and, as a benefit, it brings a positive relation to science, especially to chemistry and pupils' development of knowledge level.

It is important to lead the young generation to decisive steps that will be related to consumer behaviour which will be positively set to protect the environment. The development of advanced materials and the application of new production technologies with the support of information and communication technologies create the new environment for the application of conditions ensuring environmental and health protection.

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