TECHNOLOGIE INFORMACYJNO-KOMUNIKACYJNE W PROCESIE KSZTAŁTOWANIA MATEMATYCZNYCH KOMPETENCJI U UCZNIÓW SZKÓŁ PONADGIMNAZJALNYCH
INFORMATION AND COMMUNICATION TECHNOLOGIES IN THE PROCESS OF DEVELOPING MATHEMATICAL COMPETENCES AMONG HIGH SCHOOL STUDENTS

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Abstract: *The article shows recommendations of European Union connected with key competences, Danish systematic of mathematical competences, overall results of PISA research in 2003 in Poland and Czech Republic. E-learning has been defined, main results of surveys aimed at teachers and students of high schools in Silesian District have been quoted. They were connected with the knowledge of using new information and communication technologies in e-learning and education. Proposal of research shows how to use computer in the process of mathematical competences formation of high schools students in Poland. They were implemented as a part of PhD thesis being conducted at pedagogical faculty of Ostrava University.*
Key words: *key competences, mathematical competences, e-learning, information and communication technologies in education.*

INTRODUCTION

To define the range of mathematical competences, we should think, what and whom teaching-learning process is typically connected with. According to W. Kopaliński, *"competence is features, range of powers(...); range one's knowledge, skills, responsibility(...)".*[1] But personal competence means, *"owning rights, power of attorney to act, to decide, having proper qualification to judge and evaluate(...)".*[2]

At the turn of 20th and 21st century there were profound economical and social changes. They were caused by globalisation encompassing all areas of life. As a result of big scientific and technological development. We have become information society. Students preparation for life in the world of information, the full using the benefits, coping with the challenges-there are main tasks of educational systems in many countries. The reviews of contents and teaching methods have been done and it has been concluded, that proper preparation of young people should give them basic competences to create possibilities of occupation and creative involvement in social, political and cultural life. These basic

[1] Kopaliński W., *Słownik wyrazów obcych i zwrotów obcojęzycznych*, Państwowe Wydawnictwo „Wiedza Powszechna", Warszawa 1967, s.201

[2] *Mały słownik języka polskiego*, (red). Skorupka S., Auderska H., Łempicka Z., Państwowe Wydawnictwo Naukowe, Warszawa 1969, s.291

competences are "key competences". They are general competences, not connected with any industry or occupation but essential in professional life.

1. EUROPEAN UNION KEY COMPETENCES RECOMMENDATIONS

Key competences were defined, developed and accepted in document "Recommendation of Council and Parliament of European Union 18th December 2006 – key competences issues in the process of long life learning". The document says *"Competences are defined as a mixture of knowledge, skills and attitudes appropriate to the situation. Key competences are those, which people need for personal development, social integration, activity and employment".*
"Recommendations…" state 8 key competences:

- native language communication;
- foreign languages communication;
- mathematical competences and basic scientific competences;
- information competences;
- learning skills;
- social and civil competences;
- activity and entrepreneurship;
- awareness and cultural expression.

2. DANISH MATHEMATICAL COMPETENCES SYSTEMATIC

They were defined by Mogens Niss as the *"ability of understanding, assessing, executing and using of mathematical operations in mathematical and non mathematical context(…). There are two types of skills except knowledge connected with mathematical competences. First is ability of questioning and answering about, in terms of and using of mathematical tools. Second is based on understanding and using mathematical language and tools".*[3] He says about 8 elements of mathematical competences:

- mathematical thinking;
- facing and solving mathematical problems;
- mathematical modelling;
- mathematical reasoning;
- mathematical being representation;
- using of mathematical symbol and formalisms;
- communication with mathematics, about mathematics and using mathematics;
- using supporting means and tools including Information Technology;

3. POLISH AND CZECH STUDENT IN PISA RESEARCH 2003

One of the most popular competences students research is PISA*(Programme for International Student Assessment)* conducted under the auspices of OECD. Results of PISA research allow to compare different countries students achievements. The aim of the

[3] Article *"Quantitative Literacy and Mathematical Competences"* http:// www.maa.org/Q1/pgs215_220.pdf. Article excerpt was translated by Maria Legutko and Stefan Turnau - website visited on 31.07.2009.

programme is to research knowledge and skills of 15 years of age students. Knowledge and skills are examined in terms of:

- reading with understanding;
- mathematical thinking(mathematics);
- scientific thinking(reasoning in science) .

The programme provides three year cycles of international assessment of students skills. In each cycle, the research always provides 3 spheres of competences, but various editions focus on one of them, what allows comparability of results in time. In 2003 they focused on the study of mathematics.

There were 41 countries all around the world taking part, 30 out of them are the members of OECD. There were 276165 students taking part in the research. 260 schools and 9919 students were examined in Czech Republic and 175 schools and 5401 students in Poland.

TABLE 1 Scale of mathematical achievements were divided into six levels. This is a description typical for each level

Level	Skills of given level
Level 6	A student is able to analyse and generalize information based on self-built model research of complex problem situation. A student is able to combine various sources of information and move freely among them. A student is able to perform advanced reasoning and draw mathematical conclusions. One is able to combine reasoning with the pace of symbolic and formal operations in creative work on a new context. A student is able to make communication precisely about reasoning, justifying the action taken.
Level 5	A student is able to model the complex situations, identify constrains and clarify reservations. One is able to compare, assess and choose proper strategies to solve problems connected with model being built. A student is able to use well developed mathematical skills with the use of proper formal and symbolic representations. One is able to assess own action and communicate own interpretation and way of reasoning.
Level 4	A student is able to work effectively with given models of real situations, identifying restrictions and making the necessary assumptions. One is able to choose and integrate various sources of information, combine them with real context. One is able to use well adapted methods in this context. A student is able to communicate, describing own interpretations, arguments and actions.
Level 3	A student is able to execute the algorithm described also with the need of sequential decision making. One can choose and use simple problems solving strategies. A student is able to interpret and draw direct conclusions from various data sources. A student is able to present results of uncomplicated interpretations and problems.
Level 2	A student is able to interpret situation demanding only simple reasoning. One is able to obtain essential information from single source and use one form of data representation. A student is able to use a simple way of acting, draw direct conclusions and literally interpret results.

Level 1	A student is able to solve typical tasks, which is simple with direct given data. A student is able to perform routine activities following simple rules. A student performs obvious actions coming straight from the task.
Under level 1	

Source: *PISA research in 2003 in Poland and Czech Republic*

TABLE 2 Percentage distribution of Polish and Czech Republic students between different levels of mathematical skills

Level	**Poland**		**Czech Republic**	
	Number of students	**Rate**	**Number of students**	**Rate**
Level 6	108	2%	496	5%
Level 5	432	8%	1289	13%
Level 4	972	18%	2083	21%
Level 3	1350	25%	2381	24%
Level 2	1350	25%	1984	20%
Level 1	810	15%	1190	12%
Under level 1	379	7%	496	5%
Summary	5401	100%	9919	100%

Source: *PISA research in 2003 in Poland and Czech Republic*

Analysing the results from the chart can be noticed, that better results were achieved in Czech Republic. 1785(18 %) students obtained results from level 5 and 6, in Poland 540 (10%) students. 379(7%) Polish students and 496(5%) Czech students obtained results under level 1 and they are not able to solve simple tasks. Chosen mathematical competences can be found in new Polish and Czech standards of matura examinations requirements.

4. THE USE OF COMPUTER IN THE PROCESS OF DEVELOPING MATHEMATICAL COMPETENCES.

The use of information technology in high schools in Poland is becoming more and more popular. Teachers see huge benefits coming from modern means supporting mathematics education. Using them during classes helps not only in developing skills but gaining more advanced information competences as well and allows better visualization of difficult mathematical and related field tasks. The research conducted by the author of the article shows that most popular computer programmes are: EduROM High School mathematics (Young Digital Poland) and Mathematics (Publisher Nowa Era)[4] or Mathcad Cabri, Gran.[5]

[4] A.Heba – *„Niektóre rezultaty badań w zakresie wykorzystania edukacyjnych programów w nauczaniu matematyki w szkole ponadgimnazjalnej”* [in:] Współczesne dylematy pedagogiczne, Koło Naukowe Pedagogów Uniwersytet Śląski – Cieszyn 2009

[5] A. Heba – *Mathematical Competences Development Using e-Learning – Research Concept.* [in:] Distance Learning, Simulation And Communication, 2009, Proceedings, Brno, Czech Republic, May 6, 2009

According to students programmes:

- support teaching process;
- make learning process more attractive;
- examine level of knowledge and skills;
- develop students interests;
- make mathematics easier and better to understand;
- facilitate the conduct of refresher exercises;
- equalize educational opportunities;
- make learning more intensive during classes.

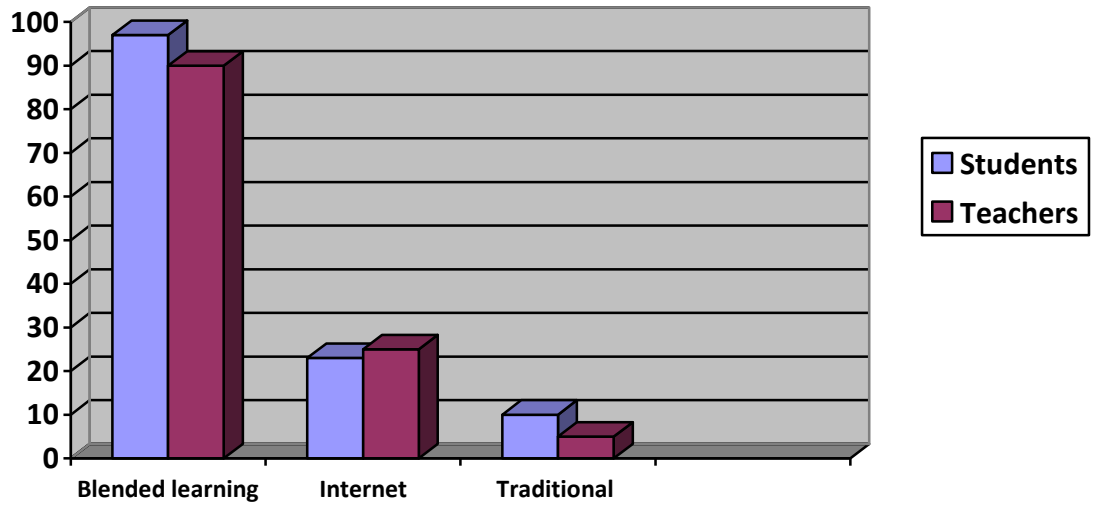
In modern society, where education plays a very important role, the possibility of quick obtaining of knowledge and skills is becoming essential. More and more important form of education have become e-learning and distance learning allowing to obtain education from prestigious universities students from most distanced parts of the world and develop traditional forms of education with new technologies, making them more effective.

According to M. J. Kubiak:

"Distance Learning is a teaching method, where teachers and students are remote from each other(sometimes far), they are not in the same place and use to provide information, except traditional ways of communication, more temporary and modern telecommunication technologies: transmitting voice, video picture, resources printed from computer. Modern technologies allow direct contact in real time between a teacher and a student with audio and teleconferences no matter, where they are".[6]

The surveys conducted by the author shows, that most students and teachers have had contact with e learning. Surveyed claim, that high schools students are still little interested in this method. Questioned about form of education they prefer, most of them 97(70%) students and 90(75%) teachers accept mixed forms (traditional and with internet). Only 13(10%) students took part in Information Technology e-learning courses conducted in schools by IT teachers and 18(15%) teachers took part in Past Degree IT and English courses.

CHART 1 Forms of education preferred by surveyed teachers and students.



Source: *Own research*

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[6] Mirosław J. Kubiak: *Wirtualna edukacja*, s. 11. Warszawa 2000. Wydawnictwo "MIKOM".

Schools can obtain huge benefits from e-learning, it can support traditional education effectively. It is called *"blended learning"*, and combines traditional and e-learning. This type of teaching minimize some disadvantages of school education such as problem with level of students in a class. According to this, a teacher usually focuses on an average student. There is a lose on poor students(they are not able to keep up with learning) and best ones(They are bored, not taking advantage of their skills). Another problem, where e-learning can be helpful is too short lessons to provide proper knowledge, use it to do different tasks and consolidate it. Students during classes mainly obtain information but developing skills, revision and consolidation are usually their homework. Disabled and sick students, who are not able to attend classes, even for a long time, are another big problem. Traditional education is not able to solve all these problems, e-learning can be supporting in these situations.

The aim of next step of educational experiment, conducted under PhD thesis is establishing and implementing e-learning course preparing for mathematics matura exam(basic level) according to Polish standards and examining of e-learning influence with carefully selected educational programmes on mathematical competences development of high school students. The course will be placed on the web platform of Silesian University(http://moodle.weinoe.us.edu.pl) in Cieszyn. The course will have hierarchical modular structure and consist of a number of standard blocks.[7]

I. Introduction to a distance learning course: ***Description of the course, Literature, Glossary, Forums, Registration survey.***

II. Subject module: ***Pre-test(assessment test), Subject resources, Tasks block, Examining, Knowledge control, Creative tasks block, Interactive communication between teachers and students and among students, Additional resources from the subject, Knowledge control.***

III. Summarising module: ***Final test, The last survey, Evaluation survey.***

Prepared course will be examined and assessed by experts-mathematics methodologists and distance learning professionals. After review and improving made available the experimental group students.

About 120 high school students from Silesian district will take part in the research. They will be divided into experimental and control groups. Experimental groups will use computer programmes in mathematics distance learning during the course. Control ones use only traditional forms without the use of computer. Then, there will be conducted pre-test research(preliminary test of quality and quantity of information in the area of various mathematical competences).

After the course there will be a knowledge test. It will be dealt with in the same area of knowledge, the same issues, with the same number of questions given(can be similar to matura examination).

In the next step, the author will perform distance tasks to examine the sustainability of knowledge gained in second step. These research will be done 6 weeks after finishing research.Then, the author will analyse the students matura examinations results after agreement with students, against the background of the region and country. Finally, after choosing appropriate statistical methods, analysis of the research will be performed.

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[7] Smyrnova-Trybulska E. *On principles of the Design and Assessment of Distance Courses* [in:] Distance Learning, Simulation And Communication, 2009, Proceedings, Brno, Czech Republic, May 6, 2009, s.159-165.

CONCLUSION

The article shows European Union recommendation connected with key competences, Danish mathematical competences systematic, overall results of PISA research in Poland and Czech Republic in 2003. E-learning has been defined, main results of survey aimed at high school students and teachers of Silesia District have been quoted. The survey shows knowledge and use of Information and Communication technologies in e-learning and education. The research proposal connected with the process of mathematical competences of Polish students have been presented. They are implemented as PhD thesis being conducted at pedagogical faculty in Ostrava University.

LITERATURE

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