Chemistry Teacher Training In Slovakia

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Abstract

The Digital Technologies (DT) have become an integral part of the didactic process of all education levels. Their integration into education is in Slovakia seen in the terms of the use of technologies. Many times there is a lot of incorrect and superficial understanding in the society of what Digital Technologies are and what role do they play in the cognitive and learning processes. Teachers are required to use technologies in the education process during their lessons. There is an ongoing training of the teachers organized by the school management. Here they learn to work with different technologies that school already provides or would like to provide. Unfortunatelly, majority of the trainings aims merely at the technology´s technical aspects and not its didactic use. The modernization of the education system counts with well prepared teachers who are trained in modern technologies, therefore the need for lifelong teacher learning at all types of schools arises. The process of transition from the traditional to modern school was launched in Slovakia by the national project Infovek Slovensko (Infoage Slovakia). The program was employed during the years 1999-2004. It aimed to prepare the young generation in Slovakia for life in the information society of the 21st century. Following this step several nation wide projects focusing on teacher education were implemented. National projects Modernization of the education system at elementary schools and Modernization of the education system at high schools are presented in this paper. Their main objectives were to achieve changes in the teaching forms and methods at schools and to prepare elementary and high school teachers. The aim group consisted of elementary and high school chemistry teachers who participated in the national projects.

Introduction

Digital Technologies have become an integral part of the didactic process of all education levels. Their integration into education is in Slovakia seen in the terms of the use of technologies. Many times there is a lot of incorrect and superficial understanding in the society of what digital technologies are and what role do they play in the cognitive and learning processes. Earle (2002) illustrated very well the current state of Technologies integration into education when saying: *"*Integration of technologies into education is not about the technologies- more importantly it is the content of education and effective teaching methods. Technologies themselves are only tools which role is to provide education content and bring up the quality of teaching methods. The focus of this issue must be in the teaching plans and the actual education process of teaching and learning. Integration is not determined by the amount or number of devices used in the teaching process but by how and why are these devices used.*"*

The school is supposed to prepare its sudents in the fields necessary for life in today´s modern society. In order for their integration in the society they need to develop new key skills and new literacy. This education should start in the primary education or even in the pre-primary education. The question is: *"Do we have teachers trained for it?"* The 2000 motto of Australian government defines one of the key areas which is necessary for the knowledge economy as: **"Education of the highest quality requires teachers of the highest quality"**. The rate of education is assessed according to the basic skills and the level of digital literacy. The key skills of the students can be developed only by teachers that are qualified and therefore competent. How are the students (competent, literate, able) depends on the teacher. Information-

Communication Technologies (ICT) and/or Digital Technologies enter and interfere into a daily life of every one of us including the teachers and students. Implementation of Digital Technologies into schools, the process of teaching and learning, in extracurricular activities, as well as their implementation into school management are directly related to the modernization of the education system. In order for the teacher to become a model for the students in using modern digital technologies (Figure 1), first of all **he needs to posses these skills and be trained in using them** in his subject teaching.
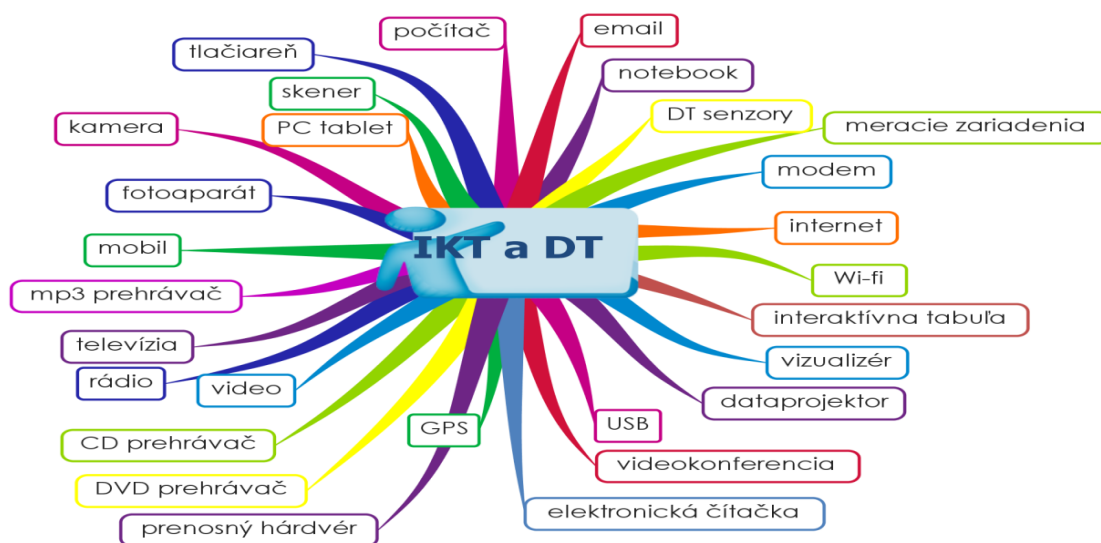
Figure 1: Overview of ICT and DT in the work of a teacher (Source: Javorová et al., 2011)

The teacher can have his computer available and use it during his classes in the multimedia classroom. He can learn Digital Technologies from the technical aspect and at the same time teach according to the motto „old in a new way". Digital Technologies support the change of thinking, however they *do not guarantee it*. Using DT is not a goal but a **tool** facilitating **higher cognitive processes** (apply, analyse, evaluate, create) and allowing focusing on the higher knowledge dimensions (conceptual and procedural). Therefore, the ability of using digital technologies does not include only the technical operations but also their **proper didactic use** for developing higher cognitive processes and knowledge dimensions.

The year 2009 can be seen as the starting year in Slovakia for the education reform. Implementation of new National education programmes (NEP) and School education programmes (SEP) began in the schools. There is a need for lifelong learning (new law on teacher education). New era of national programmes for teacher education with the support of the Structural funds began.

The most extensive are the national projects Modernization of the education process at the elementary and high schools (NEP ES, NEP HS). **Objectives of these projects** are to reach a change in the form of teaching at schools which will lead to modernization by integrating modern Digital Technologies into the teaching process as well as preparing the teachers for active implementation of the school reform by adjusting the education system to the needs of the knowledge society. The projects aim to innovate and upgrade the curriculum and teaching methods, and especially provide the training of new skills to prepare the teachers for the work in the Modern school of the 21st century (less memorizing for students, more interesting and varied lessons, better opportunities for teachers´ self-realization and new system of career development).

The projects were carried out during 2008-2013 by the Institute of information and education prognosses. The professional guarantees of the project are the Faculty of Natural Sciences of the Commenius Univeristy in Bratislava and the Faculty of Natural Sciences of Pavel Jozef Safarik Univeristy in Kosice. The project group of NEP ES and NEP HS consists of 4705 elementary school teachers and 2145 (305 from Bratislava, 1840 from outside) high school teachers covering the whole area of Slovak Republic. They teach at least one of these subjects: elementary level subjects, mathematics, physics, chemistry, natural sciences, biology, Slovak language, history, geography, music and fine art education (Tab.1). The expert teams prepared a set of 20 publications, which cover all project issues beginning with digital literacy, continuing with didactic techniques and finishing with the use of actual technologies in the selected subject classes. An overview of the number of participating schools and attending teachers can be seen in Tab.2.

Tab. 1 Overview of selected subjects for NEP ES and NEP HS

Selected subjects foor NEP ES	Selected subjects for NEP HS
• Elementary level subjects • Mathematics • Chemistry • Physics • Biology • Slovak language • History • Geography • Fine art education • Music education	• Mathematics • Chemistry • Physiscs • Biology • Slovak languagae • History • Geography

Tab. 2 Overview of the number of participating schools and attending teachers

	Estimated number	Real number	
Elementary schools	2476	2191	**88,49%**
Elementary school teachers	4705	4684	**99,55%**
High schools	851	797	**93,65%**
High school teachers	2145	2344	**109,27%**

MODUL 1 – Digital literacy of the teacher

At the beginning of the training the teachers were divide into two levels according to the level of their entry digital literacy:
- Teacher digital literacy for intermediate students (12 attended hours)
- Teacher digital literacy for advanced students (6 attended hours)

The aim of Module 1 was to create the same „starting position" in the common digital literacy field for the participating teachers (gaining or further development of their digital literacy).

Following topics were presented at the Module 1 meetings:
1. *Instead of the introduction* (introductory word about working with the study material)
2. *Let the technology work for us* (basic characteristics and activities of the operating system installed on the computer)
3. *How we will know about each other* (how to comunicate online, how does the program portal eMVP work)
4. *Basic digital literacy of the teacher* (what is a digital literacy, how to work with MS Office 2007 (MS
5. Word 2007, MS Excel 2007, MS PowerPoint 2007): work with texts, tables, diagrams, making presentations, work with internet, searching online, communication online, videoconferences)

MODUL 2 – Modern didactic technique in the teacher work

In the second module the teachers became familiar with a modern didactic technique and its effective use in the education process. The scope of daily form of education for the module 2 was 18 training hours (3 attended meetings).

The meetings of Module 2 included these lessons:
1. *Instead of the introduction* (offers an overview of digital working tools of a modern teacher)
2. *How to reach the modern school with a support of Digital Technologies* (examples of the use of social networks in the teacher work, how could the digital office of a modern teacher look like, the classroom-my kingdom)
3. *Let the modern didactic technology serve us well I.*

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a. Digital display
b. Digital image, sound and video processing
c. Interactive didactic system
4. *Let the modern didactic technology serve us well II.*
a. Exploring the surrounding world (natural science subjects)
b. Our daily digital tools (humanities)

MODUL 3 – Using the ICT in a selected subject

In the last module the teachers were divided according to their approbation teaching subject and type of school where they teach. The objectives of Module 3 were: creating own context of modernization of education in the selected subjects (creating own didactic models by applying ICT in the teaching of these subjects), as well as becoming familiar with examples of models applying ICT supported digital content into the teaching process at elementary and high school levels.

Module 3 consisted of two parts: a common part and a part related to the teaching subject and type of school. The education within Module 3 included 30 training hours (5 attended meetings: 1 common- together, remaining 4 meetings focused on the use of ICT in the subject).

The content of the meetings during Module 3 for the subject of **Chemistry at the elementary schools** included these lessons:

1. *Common part: Introduction, The change of school, The change of classroom* (getting to know the modern school concepts, the change of traditional school to modern school for the 21st century),
2. *Key skills* (overview of key skills and examples of their development types),
3. *Innovative methods in teaching chemistry* (examples of the use of innovative and activating methods in chemistry teaching),
4. *Software in chemistry teaching* (practical examples of the software use in chemistry teaching e.g, MS Office, ChemSketch, HotPotatoes, EclipseCrossWord, Jigs@wPuzzle, Yenka, Periodic Table Classic and learning their basic functions and tools)
5. *Experimenting* (legislature, constructivist approach in the experiments as a method for developing KK and simulation examples, chemical experiment visualisations)
6. *Training with a computer* (computer supported labs – Vernier, COACH, PASCO, practical examples of using the measuring devices in the chemistry teaching at elementary schools)
7. *I will note an address* (e-content database – creating web page database)
8. *The planet of knowledge* (working with the education portal The planet of knowledge, creating own teaching presentations, creating student tasks, learning the basic functions and tools of the teachers´ environment, practical examples of using The planet of knowledge in teaching process.)
9. *Interactive board – interactive to touch* (practical examples of using the intercative board in teaching chemistry, learning the basic functions and tools of the interactive board Smartboard, QOMO, Activboard
10. *Project teaching* (what is a project, how to plan, organize, utilize and evaluate it, examples of realized projects)
11. *How to evaluate students* (new ways of student evaluation, self evaluation, using the evaluation charts)

The content of the meetings during Module 3 for the subject of **Chemistry at the high schools** included these lessons:

1. *Common part: Introduction, The change of school, The change of classroom* (getting to know the modern school concepts, the change of traditional school to modern school for the 21st century),
2. *Key skills* (overview of key skills and examples of their development types),
3. *Digital Technologies in chemistry teaching, practical examples of the software use in teaching chemistry e.g. the office software* MS Office, ChemLab, Chemix 1.0, Avogadro, Ascalaph Graphics, Isis Draw, learning the basic functions and tools of the software ChemSketch, practical use examples)
4. *Chemistry experiment visualisations, examples of the daily life chemistry experiments, creating experiment database*)
5. *Connection of experiment and computer* (computer measuring devices, working with the school measuring device COACH 6)

Lifelong Learning Programme

6. *Interactive board – communication tool or student imagination tool* (practical examples of the interactive board use in chemistry teaching, learning the basic functions and tools of the interactive board Smartboard, QOMO, Activboard)
7. *Long distance and e-learning education* (e-learning basic features, examples of LMS Moodle etc.)
12. *Where do I find the teaching material?* (working with the education portal The planet of knowledge, creating own teaching presentations, creating student tasks, learning the basic functions and tools of the teachers´ environment, practical examples of using The planet of knowledge in teaching process.)
8. *Project teaching* (project teaching proposals)
9. *New ways of evaluation* (evaluation key questions, new ways of student evaluation, self evaluation, using the evaluation charts, authentic evaluation)
10. *Examples of open door lessons*

The participating teacher will enter the final stage of education- writing the final thesis only after completing all modules and turning in the online projects. The expert team of each subject designed the final thesis topics which can be found on the project portal NEP. 18 topics were proposed for the chemistry teachers of elementary and high schools. One of it is optional. The teachers have the opportunity to choose one type of these thesis topic groups:
- Research work
- Didactic project
- Qualified teaching aid design of ICT- based with a manual

Tab. 3 Examples of some thesis topics for the subjects of elementary school Chemistry (ES) and high school Chemistry (HS)

Thesis topics for ES/HS Chemistry	Description
1 ES/HS Chemical action- visualization of the experiments	Developing a set of chemical experiments using DT (dynamic video recording with the corresponding audio recording), and develeloping a methodology for their use in the basic type lessons.
2 ES/HS Organic chemistry- visualization of the experiments	
3 ES/HS Chemistry around us- visualization of the experiments (using available materials from everyday life)	
4 ES/HS Chemical action- chemistry with fun and play	Creating instructional materials (worksheets, tests, puzzles, quizes, memory and other games, word searches...) using the activating methods (problem teaching, games, constructivism, experience learning, project methods etc.) with a support of DT making chemistry more familiar and attractive for the students.
5 ES/HS Pretending to be a chemistry researcher	Developing instructional material for the use of computer supported lab in chemistry teaching, in field measuring (monitoring sets, instruments, digital measuring devices- thermometer, pH meter, measuring the concentration of gasses in the atmosphere, soil quaility surveys, the use of mobile labs).
6 ES/HS Creating a test database for any selected topic area	Creating a test database in any selected digital environment (LMS Moodle, Class Server, www.polleverywhere.com, www.purposegames.com, Blog, Active Inspire, Hot Potatoes, ...)

7 ES/HS	Developing a set of methodological material focusing on the key skills using the experience teaching in chemistry or interdisciplinary task solving.
Discovering the beauty of chemistry (interfield topic)	
8 ES/HS	Creating a draft of e-learning course in LMS environment (Moodle, The planet of knowledge atc.) for any selected topic field using various activities (books, tests, assignments, inserting files, forum etc.) followed by its testing on sample amount of students and its verification by different forms of activities (questionnaire).
E-learning courses for the use of combined forms of education for ES and HS	
9 ES/HS	Designing and describing in detail teh ways of changing the learning environment- classrooms (chemistry classrooms, natural science labs) for the classroom of the 21st century. Find out the opinion of the students and teachers using a questionnaire, survey or interview methods on how their education environment THE CLASSROOM OF THE 21st CENTURY should look like with the maximum use of DT. Statistically process the results.
The change of my classroom (interfield topic)	

Some of the dates from the duration of the participants´ training within the projects NEP ES and NEP HS:

- ✓ September 2009 – February 2010 – Module 1training finished.
- ✓ April 2010 – Module 2 training beginning,
    - – Module 3 preparation by the expert groups for each subject.
- ✓ **September 2010** – Module 3 training beginning.
- ✓ During 2010 40% participants were trained within Modules 2 and 3.
- ✓ March 2011 – first thesis defenses and final exams.
- ✓ **December 2012** – Module 3 training finished.

307 elementary school chemistry teachers were enrolled in the project as well as 197 high school teachers. All of them are trained. By March 2013 1174 elementary school teachers succesfully defended their thesis and passed final exams as well as 528 high school teachers of all subjects and types of schools. An overview of the graduates cann be seen in the following figures.
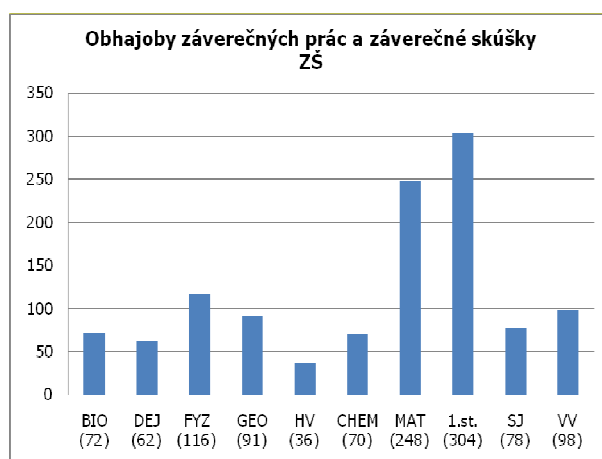

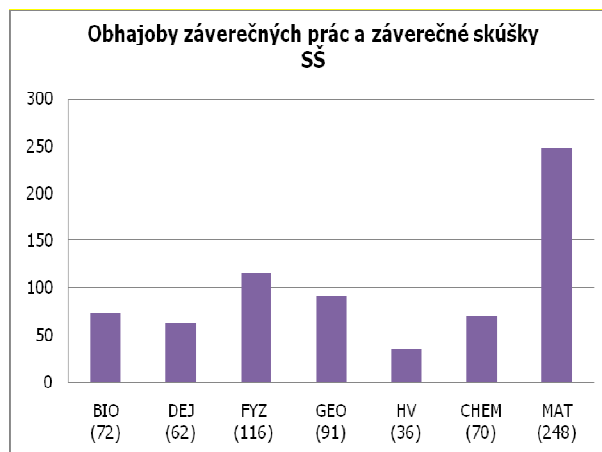**Figure 2: Thesis defense and final exams in the ES subjects**

Figure 3 : Thesis defense and final exams in the HS subjects

Conclusion

We live in a world of Digital Technology (*Digital-Age*) and for our students this world is natural. Without ICT or DT one cannot imagine everyday life. It is only natural for our students to take advantage of the latest technologies. We must realize that computer plays a major role in the education process, and that not only for the student in regards to his future occupation and integration in the society. It also indicates the quality of education. The teacher is now put into a very difficult position of continual learning and developing new professional skills (pedagogical, technological etc.). For the 21st century the basic skills and literacy such as reading, writing and arithmetic are not sufficient any more. It is necessary to prepare the students in the fields needed for a life in today´s modern society. The project of Modernization of the education process allows innovative and active chemistry teachers to gain new skills for the work in a modern school with the support of Digital Technologies. Without them, they cannot provide their already "digital students" the joy of learning, discovery and creation and so they will not develop their need for lifelong learning.

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