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PREFACE

Sixth conference *Technics and Informatics in Education – TIO 2016* which acquired the status of an International conference for the first time this year, pursues an important objective to promote and support research in education of new generations in technical and technological fields at all levels of education, and contribute to technology development and education improvement.

For this Conference, some 86 papers have been submitted within various fields of technical, IT and technology-supported education at all education levels – primary, secondary, high education and education for adults. After reviewing, 71 papers have been accepted for current edition of Proceedings in the form of plenary lectures and original scientific papers by the authors from countries within the region and beyond.

Authors are responsible for any spelling, grammar and stylistic errors in their work.

Conference papers in the *Proceedings TIO 2016* are organized in the following topics:

- Plenary lectures
- Challenges in technical and IT education – from preschool to university
- Information and Educational Technologies
- Professional development of IT and technical education teachers and European educational perspective
- Engineering Education.

Special activities within the Conference are the following:

- Remote experiments - NeReLa Demo session
- Day of Computing
- Poster Session: Research project on Faculty of Technical Sciences

The Scientific and Organizing Committee wish to thank all the scientific and professional employees from various fields who contributed to the Conference.

We would like to thank Partner Institutions which participated as co-organizers of the Conference.

We express special thanks to the Ministry of Education, Science and Technological Development of the Republic of Serbia for financial contribution to this scientific gathering

Chairman of the Organizing Committee
Dr Ivan Milićević, Assistant Professor

CHAIRMEN'S FOREWORD

Faculty of Technical Sciences Čačak, University of Kragujevac, has the honour to organize International Scientific Conference 'Technics and Informatics in Education – TIO 2016'.

The Conference continues the tradition of gathering scientific associates and professionals in technical, technological and IT education in primary and secondary schools in Serbia. For the last 50 years this assembly has been organized in various forms (scientific and professional conferences and consultations on technical education, information technologies, technical seminars, etc.). These scientific and professional conferences have had a huge impact on the development of technical education, mostly in primary education, as well as in secondary education. The impact is also noticeable in both higher and university education. Five National conferences with International participation titled Technics and Informatics in Education were held in 2006, 2008, 2010, 2012 and 2014. Still, the necessity for continuous, organized scientific assembly related to technics and informatics in new surrounding and connection with other technologies has increased.

The aim of the conference TIO 2016 is to improve the exchange of knowledge and experience between experts, scientific associates and professionals from Serbia, neighbouring countries and Europe, engaged in the subject matter. The conference will provide an analytical review of technical (technological) and IT education, as well as education regarding technical (technological) and IT achievements including assistive technology, teaching aids, student books, etc. Teacher training is considered highly significant for research and development in education in this field.

The Conference includes technical (technological) education at all levels: from preschool institutions, primary and secondary schools over higher and university education, to various forms of lifelong learning.

Furthermore, the special emphasis will be given to the place, importance, and role of informatics and IT in technical and professional education, as well as correlation with other natural, social and education science.

A comprehensive analytical review will be given on the state of education in the fields of technics and informatics, as well as the contribution of technical and IT education to other fields.

The conference results are expected to provide the basis for planning the development of education in Serbia, especially in the fields of technical (technological) education, engineering, IT and informatics. The results are also expected to support and contribute to the exchange of educational patterns in the neighbouring region and coordination with European trends in this field.

We hope that experience gained at the Conference will be very useful both for the participants and for the development of technical-technological education field.

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Application of ICT in teaching biology (Example of a lesson)

Snezana Stavreva Veselinovska[1] and Snezana Kirova[1]
[1] University "GoceDelcev" – Stip, R. Macedonia
e-mail snezana.veselinovska@ugd.edu.mk

Abstract: *The computer programs as a didactic aid are often described in didactic literature all over the world. It is not enough that they play, for instance, motivational, exercising, synthesizing or supervising function, they are to be made an independent source of reliable, easily comprehensible information, given in a way that activates students. It is also important not to replace various functions and tasks of didactic aids applied in the process of teaching-learning Biology with each other, but only to interfere skillfully. It is underlined that school practice requires methodically grounded application of these aids in the processes of teaching and educating. In this paper in selected ICT tools have been presented in the light of teaching principles and cognitive activities model. Computer science education, information and communication technology (ICT) are at present becoming one of the most important elements defining the basic competences of students. Information technology integrates medial, informative and computer science education, but also all the educational subjects mentioned in the curriculum basis of general education. In science and biology education there increasingly appear concepts of integrated teaching, showing the student the world in a holistic manner. The principle of universal activity of students in cognitive, emotional and motivation, as well as in practical sphere is preferred. More and more often attention is paid to the fact that the contemporary problem is not so much lack of information as its surplus, and the crowd of information as well as its unnecessary excess of details may be an effective tool of disinformation. Hence forming in students such skills as selection, evaluation and organizing of information (forming its structure) seems justified, so that they can serve drawing conclusions.*

Keywords: *information and communication technology (ICT), biology, learning and teaching, knowledge*

1. INTRODUCTION

Information and Communication Technologies (ICT) is a term used to denote all computer and communication technologies.

ICT has become an integral part of the educational system and as a support to teachers in the implementation of the traditional teaching process as well as in the process of learning and teaching.

The new educational paradigm focuses on the student – the student is placed in the center while the environments are learning resources both in terms of time and in terms of place

and learning styles. Everything is orientated towards the student and covered with one expression - learning resources (teachers, knowledge, technologies, media, organization....

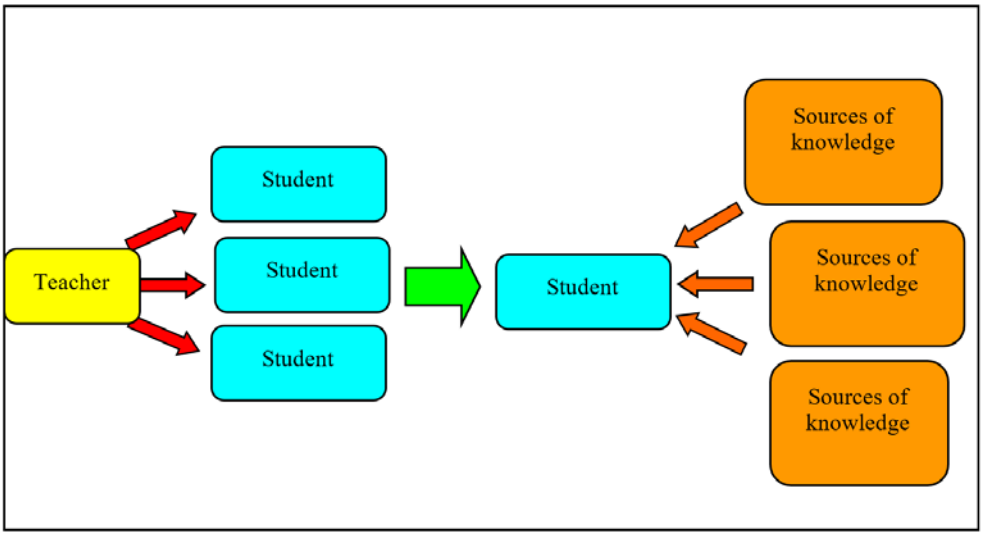


Figure 1. *Transfer of the traditional teaching paradigm into a new advanced one*

With the use of computers and the Internet students can:

- find the desired information;
- explore a variety of topics;
- develop the capacity for finding and gathering information and
- collaborate with other students on projects using the Internet.

Nevertheless, the computers and the Internet should be seen as a supplement, not as a substitute for the traditional way of learning.

It is therefore considered that e-learning can be seen as a completely independent form of education, but also as a component or a complement of classical education. We implement mixed education: a combination of classical teaching in the classroom and teaching using ICT. A popular way of describing e - learning is using the "timeline" of e-learning which shows education as a continuum on whose left side there is classical instruction (F2F - face to face lecturing). Moving towards e - learning starts with the introduction of ICT into F2F teaching. In the middle of the timeline is the mixed learning approach. Online education is located on the right end of this continuum.

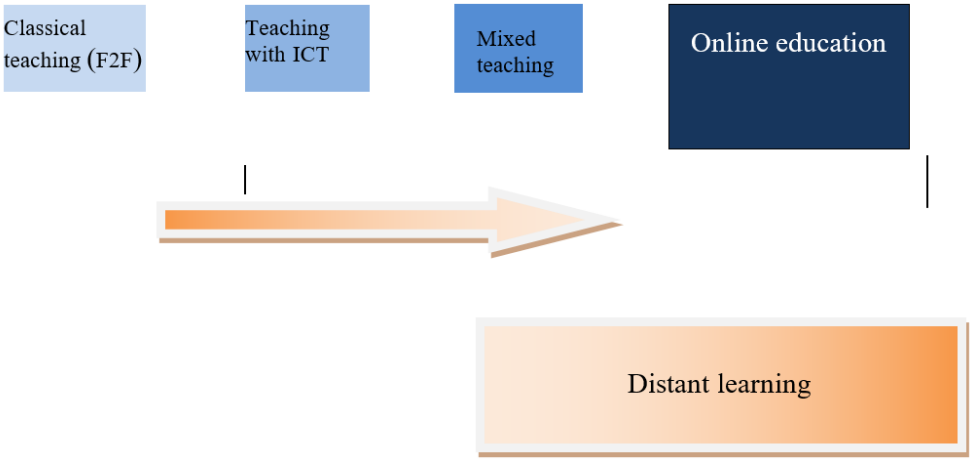


Figure 2. *Classical and online teaching*

The teachers' obligations are:

- To identify strategies for gathering information;
- To determine the relevance of the information they have found;
- To develop problem solving skills, and
- To evaluate the efficiency and effectiveness of the solutions.

1.1. An example of the use of computers and the internet in practice

One of the most successful applications of computers and the Internet so far in practice is the system of education of the American company Cisco known as the Cisco Networking Academy. It is a combination of teaching under the guidance of an instructor who teaches by the curriculum to which he/she approaches by using the internet technology, and the evaluation of knowledge is a combination of practical texts and texts performed on the computer. The test results are obtained immediately so the average grade for the entire group as well as the average score of the same test on a global level are known without delay.

Educational goals and tasks in modern scientific - technological and social changes are not and cannot be marginal pedagogical problems as they were treated by our pedagogical science in the second half of the last century. Pedagogy, which aims to discover and explore the laws of the educational process, should approach the aims and objectives of education as basic and initial pedagogical problems. Pedagogical science should incorporate the goals and objectives of education into its categorial system, because the core understanding of pedagogical problems (raising strategy, content, forms and methods, the position of the subject) derives from it. Without such a relation of pedagogical science to the goals and tasks of upbringing it will not be possible to develop teaching methods for individual subjects as well as new strategies of teaching, learning and self-learning. Teaching methods for information education also faced this problem when it was established.

2. GOAL, TASKS AND CONTENT OF INFORMATION EDUCATION

Educational goals and tasks in modern scientific - technological and social changes are not and cannot be marginal pedagogical problems as they were treated by our pedagogical

science in the second half of the last century. Pedagogy, which aims to discover and explore the laws of the educational process, should approach the aims and objectives of education as basic and initial pedagogical problems. Pedagogical science should incorporate the goals and objectives of education into its categorial system, because the core understanding of pedagogical problems (raising strategy, content, forms and methods, the position of the subject) derives from it. Without such a relation of pedagogical science to the goals and tasks of upbringing it will not be possible to develop teaching methods for individual subjects as well as new strategies of teaching, learning and self-learning. Teaching methods for information education also faced this problem when it was established.

2.1. General goal of education

Our understanding of the goal of education as an element of the categorized system of pedagogy shows that it is necessary to redefine the overall objective that needs to be incorporated in the process of education (processuality) and to determine the interrelationships between specific and general objectives of education. At the end of the last century, after the fall of the ideal of the socialist society known as a "universally developed socialist personality", efforts were made to redefine the general goal of education. Thus the goal of education is defined as the acquisition of knowledge of social and civilizational values, maximal development of psycho-physical abilities, critical thinking and creativity. Such a definition of objectives creates four important features:

- acquiring basic knowledge of social and civilizational values;
- Maximal development of innate and acquired psycho-physical abilities;
- Development of critical thinking and
- Encouraging and promoting creativity at different levels of psycho-physical age and in all areas (subjects).

With such definition the overall objective of education is free from ideological and other fleeting definitions. Instead of the term to learn new terms that define the essence of learning, self-learning and creation are introduced. Beside this, the new definition of the objective was incorporated into the very process of education (processuality of the goal). The redefined purpose of education is not incorporated only in the "ideal personality" but in the social ideal also. The overall objective of education based on fundamental laws of personality development becomes a reliable criterion for monitoring in the course of the immediate educational process and for evaluating its outcome. Redefining of the general aim of education imposes the need for reassessment of values and range of specific and individual goals, their classification and mutual relationships.

3. INFORMATION EDUCATION AND INTERACTIVE LEARNING

In the frame of the teaching process reforms during recent years interactive learning is increasingly being confirmed as one of the modern pedagogical innovations in our country too. Regarding the fact that information education is one of the important components of the school system reform, there is an important connection and complementarity between these two modern innovations.

3.1. Notion and essence of interactive learning and teaching

In our country there are also terminological issues about the meaning of the notion of interactive teaching, interactive learning and interactive method. Whether it is about the

entire curriculum, the learning process or the application of one method, interaction builds a new way of communicating on the relation teacher, student and curriculum content. Namely, this introduces a new interdependence, interaction and mutual action of students who study together. Accordingly "interactive learning is a process that results in relatively permanent changes in thinking and behavior that are created on the basis of experience, tradition and practice realized in social interaction. (Suzik, 1999, p. 24).

In addition to the advantages of interactive learning compared to the traditional teaching (greater quantity and quality of knowledge) it also encourages the realization of social interaction and social relationships. To establish efficient interaction it is necessary for course work to be organized in small groups, to encourage interdependence between members of the group, to support the inclusion of all students in active work in groups, to encourage and develop interpersonal abilities and emotional environment for group work. So, the essence of interactive learning in teaching is the acquisition of knowledge (cognitive component) and the development of interpersonal and social relationships (affective component). The results of empirical studies have shown that interactive learning has some advantages over classical teaching.

3.2. Interactive learning in information education

In information education as well as in all other types of education and teaching it is reasonable to apply various types of interactive learning. Basic rules of interaction should be observed when applying interactive learning in information education, but only in the form of specific objectives and content of this education. It is therefore important to observe the following elements:

a) The main goal and task of information education;

b) The nature and character of the information content taught in an interactive manner (not all contents of information education is adequate for interactive learning);

c) The level of knowledge of methodical procedures in interactive learning;

d) The teacher's level of training for organizing and introducing various forms of interactive learning and

e) The level of students' training in interactive learning, procedures of interaction and actions of interdependence and mutual action of groups.

Today, owing to universal teaching aids, the most complex organisms can be shown to students, the farthest geographical area with endemic species can be made available, the smallest and most complicated part visible with a microscope (e.g. micro-organisms and microscopic preparations) can be shown.

An obvious example is the electronic encyclopedia, ENCARTA, where the display shows life on the planet and where you can choose the desired area of research.

3.3. Example

In the area of environmental content we can choose any area depending on which educational content is processed (air, water, soil, etc.).

By selecting the teaching content AIR, students are given the opportunity to process this content through: questions, dilemma games, videos related to this teaching content, teaching paper to verify the previous knowledge and skills of students during class and individual activities.

This type of class using ICT in teaching activity allows all students to be active and keep their attention during the entire class. Besides the fact that this multimedia CD can be played on each student's PC individually, it is also possible to present its content with a presentation on an LCD projector, if the school does not have a computer for each student individually.

3.4. Tests

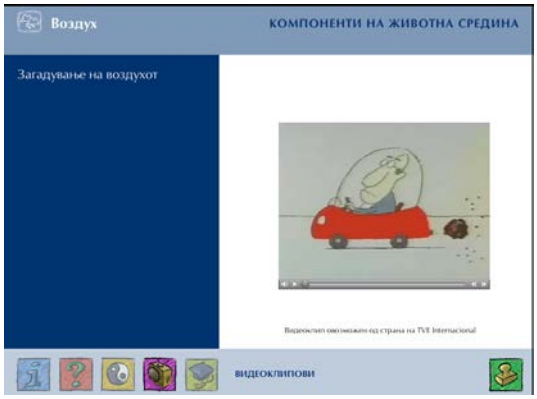
The test consists of alternative answers of which you need to choose one by clicking which is indicated on the table as the right or wrong answer. Finally, the sum of correct points is shown.

3.5. Dilemma - games

Choosing dilemma - games allows students take the role of authority that can solve a problem. First there is a problem and some possible solutions are offered by selecting numbers from 1 to 4.

This procedure encourages students to think independently and it helps their activation in solving problems.

3.6. Video



By choosing this option all students are animated in the course of the class; this clip educates students and they get familiar with harmful air pollutants. With this kind of work the teaching process becomes more flexible. This means that instead of the teacher being in the center, the focus is on the student. Thus the teacher must use new methods and techniques in his/her work.

As an example we will show the realization of one lesson in biology.

4. DAILY PLANNING OF A LESSON IN BIOLOGY, IX GRADE, THEME: BREATHING, EXCHANGE OF GASES (THEME NO. 7)

4.1. Teaching unit

Anticipated outcomes:
Students:
- list the parts and functions of the respiratory tract;
- Sequentially explain the path of air through the airways;
- explain the importance of breathing;
- explain the mechanism of breathing and the role of the diaphragm and intercostal muscles;
- explain gas exchange in the cell and in the alveoli in the lungs;
- should know how to protect themselves against diseases of the airways.
- know the procedures of artificial respiration;
- should be enabled to use the ICT portal school where there are texts, tests and animations with the specified content
- Recognize the importance of hygiene for healthy respiratory organs through an eco-topic - Maintenance of the building and of the healthy school environment.

Materials and equipment needed for realization

- Computers
- Encyclopedias
- Textbook

Forms of work:

- Joint work,
- individual work

Methods of work:

- 1.oral answers to questions asked by the teacher
- 2.oral presentations
- 3.project work

4.2. Activities and guidance from the previous lesson

Teacher
Prepares goals, methods and teaching aids for the realization of the content; guides and encourages activities; has

Activities during class
Introduction
Through questions they revise the content about breathing, and after that, through brainstorming students consult about how to make presentations.

The students are shown an example of a presentation already made by a student, and then they are directed to the following portal:

http://skoool.mk/sites/skoool.mk/files/mk/KS3/Biology/respiratory_system/index.html

They should visit in order to complete their knowledge, to get informed, to test themselves by answering test questions with direct results about correct/incorrect answers, and in the part with animation they should take on the role of doctors and "perform surgery" on a patient and align respiratory organs accurately with which the patient is revived, or the other way round: if they do not know the correct order of respiratory organs, the patient dies.

4.3. Final activities 5 min.

We discuss whose presentation is completely finished and beautiful and which suits best to what they are studying; thus students perform self-assessment of their own work.After that students fill the scoring lists for oral presentations and the total sum of points shows which is the best presentation.

Then the students are informed that during next class the mechanism of breathing will be studied and that they should bring balloons and plastic bottles because we will be making a model of lungs.

List of analytic scoring in the evaluation of oral presentations

POINTS	**ORGANIZATION**
4 POINTS (REMARKABLE)	Well-organized presentation. Thoughts have a logical and spontaneous order. It has a good flow
3 POINTS (GOOD)	Well organized presentation. Most of the thoughts are arranged logically. There are several harmonious transitions between parts
2 POINTS (ACCEPTABLE)	Poorly organized presentation. Thoughts do not follow one after another. The transitions are weak. It is difficult to follow the logic of the presentation.
1 POINT (UNACCEPTABLE)	There is no organization of the presentation at all. Random collection of loosely connected ideas.

POINTS	**CONTENT**
4 POINTS (REMARKABLE)	It shows very good understanding of important ideas.
3 POINTS(GOOD)	The student includes some important ideas that relate to the topic. The student has knowledge of the topic.
2 POINTS(ACCEPTABLE)	The student perhaps includes a significant idea or a few facts, but does not develop the ideas or connections between ideas.
1 POINT (UNACCEPTABLE)	The student shows limited knowledge of the subject.
POINTS	**PRESENTATION**
4 POINTS (REMARKABLE)	Calm with clear articulation, adequate volume of voice, showing self-confidence.
3 POINTS (GOOD)	Relatively clear articulation, fairly steady pace, mainly admirable.
2 POINTS (ACCEPTABLE)	With some murmuring, uneven pace, with little or no expression.
1 POINT (UNACCEPTABLE)	Difficult to understand, with a very slow pace, the speaker seems unmotivated.

4.4. Notes and reflections on the lesson implementation

Through a well-planned strategy by asking a number of questions students were encouraged to think, observe and examine previous knowledge and their acquired knowledge resulted in cooperativeness in providing ideas, mutual assistance and planning presentations; as a result, students had successful presentations and most of them were successfully completed.

Few students showed little uncertainty when they needed to find relevant content that matched the material they studied but I helped these students by selecting some content that they further added to their presentations.

The positive side of such lessons is that they are more interesting for students and include all of them to equally participate in the preparation of the given task without having the feeling of inferiority; in this type of classes students stand out with their cooperativeness, individuality, interest and desire to help each other.

All stages of the lesson were directed to fulfilling the anticipated objectives which enabled

students to recognize, list, explore, describe, and analyze, thus creating an interesting lesson.

5. CONCLUSION

Integrating computers in teaching biology allows bringing educational content closer to students, facilitation of learning, revision and acquisition of knowledge, as well as its usage.

It also allows integrating the teaching process into modern technological developments.
What does this kind of teaching enable? Such teaching has a lot of advantages:
1. Students develop their personalities through all aspects, at all levels, because this kind of teaching is also applicable to students with lower levels of knowledge;
2. It helps to complete a number of tasks and to advance the lesson objectives;
3. It helps students to fuse multiple types of knowledge and to expand it;
4. It encourages students to be creative and increases the research method;
5. Students acquire the habit of turning their individual work into collective work because they will be networked into joint work etc.

Why is this manner of work with the application of ICT better than the ordinary type of instruction?
There are a number of reasons.
Disadvantages of the traditional lesson:
1. The lesson will not be interesting if students just sit and listen to the teacher and then reply to questions:
2. Inert atmosphere;
3. Students are not concentrated in the classroom and the teacher it cannot control it;
4. The teacher may not know how much the student has mastered the course material
5. The teacher has no opportunity to ask various questions

Benefits of e – learning
1. All students are involved in the work during the lesson
2. There is interest in finding new content
3. The atmosphere is not inert
4. The teacher has feedback on the level of students' knowledge
5. All students will be engaged in the teaching content
6. There are questions of different nature
7. All students repeat the teaching unit
8. Through revision of the teaching material the students will further acquire a certain degree of knowledge.

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