

## Research on Integrating the Information and Communication Technologies within the Process of Teaching-Learning

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### Abstract

*Rapid development of the informational technology and communications, directly connected to the Internet development and the attached communications ways, leded to a more intense implication of those in education. New terms such as: on-line education, e-learning educational systems are more and more met..*

*In this paper we analyzed, first of all, the premises of the development of the informatics technologies applied in the learning process. Implementing the multimedia technologies in the teaching-learning process implies a rise of attention, of consciously information's volume and diminishing the needed time for instruction.*

*Than we presented a solution for improving and rising the management efficiency of the students' activities for the courses in the current semester, using Web Technologies. Moreover, using this solution given by the described application, students of any faculty can have anytime and anywhere access at information such as: courses materials, virtual labs materials, marks given for partial or final tests, statistics regarding the scholar situations.*

**Key words:** Internet, multimedia technologies, e-learning.

**JEL Classification:** C60, C61, C88, C92.

### 1. Introduction

The beginning of the third millennium is characterized by a sizable change regarding the communication technologies and the information and calculus systems. Their potential is able to revolutionize the entire social system. On such terms, the education system should play the promoter role of the information technologies, to make them accessible to the entire society.

The information technologies are a set of methods of the producing processes and the programmed technical resources joined within a technological chain that provides information accumulation, storage and display, in order to lower the difficulty of using the information resources and to increase its efficiency and security.

The education structure change will involve the teacher's role change. In addition, the network technologies provide access to the educational information and training programs that will

increase the teachers' training and their abilities to use the information systems. Therefore the scientific projects „The ARIADNE Project”, „The Study Place Project” [15], [19] are very important to create new training programs and a “new training space”. This is “a background of online scientific resources and management interfaces developed by the interference of the information processing technologies and communication technologies”. The virtual libraries represent its basis and one of the services provided by the global Internet network. The value of the global networks cannot be contested and deserves a special attention. The networks of Internet type have a strong influence in the education system, because they “provide a wide range of educational information” [1]. The following examples prove the above mentioned issues: the project “Distance Individual Study” of the state Minnesota (USA) provides a list with 450 training courses with obligatory network registration. These courses are gathered from over 80 academies, sections and departments of the universities of Minnesota. This list includes new training courses and older updated courses (with periodical updates and changes). The list completes every 24 hours while the expired information deletes. Thus the teachers may complete and improve their pedagogical experience. Since the Internet network was implemented in the educational process [20], the teachers could publish their course notes on the network. The users (pupils/ students) may access the latest accomplishments of the educational science because the Internet information updates quite quickly. This example may be used for “the global study room”, accessible through Internet. “The volume of information provided in this virtual study room is various, from technical to art subjects” [2], and the information is provided by different universities and institutes.

The scientific research institutes, specialized in implementing new pedagogical technologies in education, pay a proper regard to the multimedia technologies. Therefore the scientists from the universities of Texas and Arizona (USA) proposed computer assisted technologies. The scientists from the Institute of New Education Technologies, University of Columbia (USA) classified the research in this field in three categories:

- a) projects for schools (modelling the education soft using network and multimedia technologies);
- b) academic projects for the higher education and scientific research institutions (to support scientific research studies);

c) political projects (regarding the financing of the scientific research studies).

The priority is to implement the information technologies in education and the above mentioned examples are an extra proof of the interference between technology and social life. This is how we will be able to meet the society's exigencies regarding the information and calculus system knowledge and operating skills, the abilities to perceive and learn the world information board, the guiding abilities in the information society, and the abilities to adapt to its requirements, so that "the practical abilities, used in different situations should correspond to the assigned/ assumed roles, in order to resolve successfully, rationally and creatively different tasks, problems and actions" [13].

The multimedia technologies (MT) are advanced information technologies and instruments to create modern education courses, and virtual classes, schools, libraries, universities, etc. All the virtual objects mentioned above form a new space – the education virtual space – and represent information sources for different educational fields, as well as education means.

The multimedia technology assists the information to be studied, a fact that increases the efficiency of the teaching-learning process. Depending on its equipment, MT offers advanced navigation environments, so that the students and teachers benefit by the possibility to search and use more efficiently the necessary information while they study. "...The multimedia facilities lower the efforts to acquire and assimilate the study information" [11] and therefore the pupils and students may save time and energy and direct to creative activities. Therefore the interactive textbooks, the e-textbooks on CD-ROM or DVD-ROM are the first steps to create the "the education information space" [8]. The need to create electronic textbooks is connected to the new information technology that developed and implemented in the different field of the teaching-learning process.

The multimedia technologies, including libraries, CD-ROMs and DVD-ROMs, deserve a special attention ("what we call multimedia finds an important place in our computers" [14]) and have a strong influence on the teaching-learning process, by providing a wide range of training and educational information [8].

In Section 2 „Technologies and communication impact on the social and economic field” we realized a study over the using of the Internet in the world, in the European Union and in Romania, as well as over the significance of the Internet, and we reached the following conclusions:

- at the end of 2006, over 38% of the EUs' citizens had access to Internet;

- the annual increase rate of the Internet users in Romania is quite high, it reaching almost 23% in the last period;

- almost half of the respondents (47.7%) access Internet from the office, and 33.6% from home.

The results of the study show that Internet is mainly used for communication, information and learning: „sending/receiving by e-mail”, „reading news” and „looking for information about/for education/studies/instruction”.

In Romanian existed a some programs and initiatives that have brought important contributions in the educational area such as:

- Leonardo da Vinci Program II – where it was realized the WBT WORLD Project that aims to improve the quality of the courses based on Internet.

- Socrates Program II (2000-2006) – with the ERASMUS project for universities learning program;

- Youth Program II (2000-2006).

In Section 3, „Determining the efficiency of multimedia technologies for the teaching/learning process”, we made an experiment by which we compared the obtained results of the two parallel groups: control group (for which was used a traditional teaching system) and the experimental group (for which was used a new teaching system based on introducing multimedia technologies). We applied statistic test „Mann-Whitney” for determining the distinctions between the two data series, after a certain characteristic.

By applying the statistic methods for processing the experimental data we found that the hypothesis about the positive impact of implementing multimedia courses (in the teaching/learning process for the experimental groups) and the rise of the efficiency of the methodic applied in the experimental groups against the traditional methodic applied for control groups were valid.

Section 4, „Implementing an application for the management of the long-distance students' teaching activity”, contents a detailed analysis of the application conception way for the management of the students' activity in a faculty (data structures, functionalities, projecting and realizing the application). E-learning platform implemented (which allows the student to access the didactic material anytime and anywhere, this way developing mobility and easiness in the theoretical activity) offers a support for teaching and learning, for testing and evaluation, for administrate the curriculum area and for monitoring the whole learning process.

The platform has four types of users, of which three of them playing administrative roles (administrator, secretary, professor) and one of them is for the students that are recorded on the platform and has a simple and adaptive architecture that contents the following interacting components: administrative component (that includes the users' administration,

secretaries' administration, administration of the discussion forum), the educational component (which allows elaborating and seeing the courses, adding, changing some chapters of the course and some questions in the test or in the evaluations, updating the themes for projects, management of the virtual labs and of some on-line labs) and the communication component (which includes using some discussions forum, informing students about the news, communicating by mail and chat with the professors that hold the disciplines).

## **2. The Impact of Information and Communication Technologies in the Social and Economical Domain from EU/Romania.**

In order to create the most competitive knowledge-based society, an essential part has to be given to the education strategy. Although each individual country is ultimately responsible for organizing its national educational system, the EU included the e-learning initiative in the eEurope project for promoting this new training system in all the member countries. The goal of eEurope project is the creation by 2010 of the most competitive knowledge-based economy, capable of sustained economical growth, which will create new jobs and will allow better social cohesion.

This new training system is a complementary system, which allows a continuous professional training, more accessible than the classical methods and very beneficial by the elimination of the geographical boundaries, unlimited and equal access for all the users' categories. The possibilities of information personalization offered by e-learning, both as language and contents structure, transform this unit into a powerful instrument for the EU objective of social integration and cultural diversity preservation.

Besides the specific benefits of unlimited access to information, the e-learning training also has long term social and economical effects. This way the citizens are going to become increasingly used to computers and Internet services which in time is creating both the trained man power for producing the information goods in the new economy and the customers for those goods and services as well.

At the very center of the eEurope project is the premise that the Internet network is essential for future economical growth, creating new jobs and

improving the quality of life not just in Europe, but everywhere in the world.

One of the first EU objectives in the eEurope project is the updating of the regulations of Internet access in order to obtain a unique telecommunications market. The liberalization of the telecommunications services started in 1980 with the objective of eliminating the monopoly situations created by the national phone companies. In March 2002 EU adopted new legal acts to bring down the number of regulations from 23 to 8, allowing thus the free competition in order to decrease the prices and increase the quality of telecommunication services. The direct result is a cheaper and faster Internet access, available for all the citizens. (Table 2.1)

As the number of Internet users increased, the enhancement of information security measures became a necessity. The EU Commission adopted in this direction security strategies for networks including the legal system to fight the information terrorism. Equally important for maintaining the users' confidence is personal data protection. Even since 1995 the European legislation in this direction was created and addendum was adopted in 1998, which insured personal data transfer between different countries using similar protection standards.

The effort of the eEurope project is not meant for the creation of some institutions or regulations, but is driven towards the coordinating and establishing a common goal in some of the political activities already evolving at a national or European level. This way every EU member country has the full right to decide over the school system and public services. However, these states have decided to learn from each other by accepting common goals and by free information exchange in order to achieve the common objectives. This procedure is called "the method of open coordination" and its implementation is the responsibility of local authorities.

In the Internet economy, its consisting elements are in a complementary relation which means that the development of one of them is generating the development of the others. In the eEurope project, the creation of interesting, useful content in the own language is going to increase the customers demand for broadband services, which will help the investments in telecommunications' infrastructure. On the other hand, in the absence of this infrastructure, there will be no encouragement to create applications and valuable contents.

Tabelul 2.2. INTERNET IN THE EU

EUROPEAN UNION	Population (estimation 2007)	Internet users	Internet services penetration (% of population)	% Internet users of the EU total	Increase % users 2000-2007
Austria	8,213,947	<b>4,650,000</b>	56.6 %	1.9 %	121.4 %
Belgia	10,516,112	<b>5,100,000</b>	48.5 %	2.0 %	155.0 %
Bulgaria	7,673,215	<b>2,200,000</b>	28.7 %	12.3 %	411.6 %
Cipru	971,391	<b>298,000</b>	30.7 %	0.1 %	148.3 %
Republica Cehă	10,209,643	<b>5,100,000</b>	50.0 %	2.0 %	410.0 %

EUROPEAN UNION	Population (estimation 2007)	Internet users	Internet services penetration (% of population)	% Internet users of the EU total	Increase % users 2000-2007
Danemarca	5,438,698	<b>3,762,500</b>	69.2 %	1.5 %	92.9 %
Estonia	1,332,987	<b>690,000</b>	51.8 %	0.3 %	88.2 %
Franța	61,350,009	<b>30,837,592</b>	50.3 %	12.3 %	262.8 %
Germania	82,509,367	<b>50,616,207</b>	61.3 %	20.2 %	110.9 %
Grecia	11,338,624	<b>3,800,000</b>	33.5 %	1.5 %	280.0 %
Ungaria	10,037,768	<b>3,050,000</b>	30.4 %	1.2 %	326.6 %
Irlanda	4,104,354	<b>2,060,000</b>	50.2 %	0.8 %	162.8 %
Italia	59,546,696	<b>30,763,848</b>	51.7 %	12.3 %	133.1 %
Letonia	2,279,366	<b>1,030,000</b>	45.2 %	0.4 %	586.7 %
Lituania	3,403,871	<b>1,221,700</b>	35.9 %	0.5 %	443.0 %
Luxembourg	463,273	<b>315,000</b>	68.0 %	0.1 %	215.0 %
Malta	386,007	<b>127,200</b>	33.0 %	0.1 %	218.0 %
Olanda	16,447,682	<b>10,806,328</b>	65.7 %	4.3 %	177.1 %
Polonia	38,109,499	<b>11,400,000</b>	29.9 %	4.5 %	307.1 %
Portugalia	10,539,564	<b>7,782,760</b>	73.8 %	3.1 %	211.3 %
Romania	21,154,226	<b>4,940,000</b>	23.4 %	27.7 %	517.5 %
Slovacia	5,379,455	<b>2,500,000</b>	46.5 %	1.0 %	284.6 %
Slovenia	1,962,856	<b>1,090,000</b>	55.5 %	0.4 %	263.3 %
Spania	45,003,663	<b>19,204,771</b>	42.7 %	7.7 %	256.4 %
Suedia	9,107,795	<b>6,800,000</b>	74.7 %	2.7 %	68.0 %
Marea Britanie	60,363,602	<b>37,600,000</b>	62.3 %	15.0 %	144.2 %
<b>Uniunea Europeană</b>	493,119,161	<b>251,031,906</b>	50.9 %	100.0 %	165.9 %

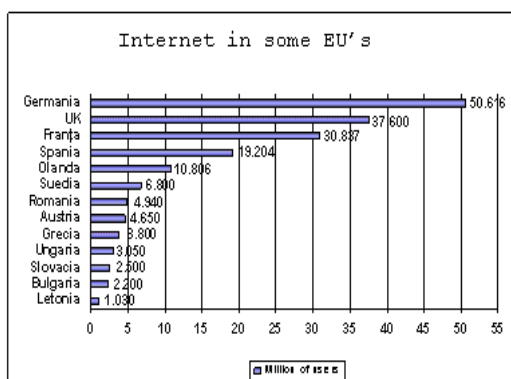
Source: <http://www.internetworldstats.com> (Internet World Stats – Usage and Population Statistics-2007)

*Diagrama 2.2. Internet in some EU's countries*

As a consequence of its integration to the European Union, Romania has to follow all the directions for the creation of an informational society previously presented. Our country has to reach the same development standards set in the eEurope project by the year 2010.

For Romania, the transition basis towards the informational society consists equally of the

economical reforms and the fundamental changes in social organization, based by investments in education and scientific research, central institutions of a knowledge-based society, as well as by supporting and promoting the intellectual and science elites. These results will not be obtain unless major changes are going to be made in the mechanism of taking decisions at all levels and also major changes in mentalities of each of us are going to be done.



The admission of Romania in the EU offers multiple opportunities to speeding the construction of the knowledge-based society, having the fundaments of the strategy of creating the European space of research and superior education [7], sustained by international partnerships and projects to obtain the knowledge transfer for using the specific instruments of this new society type: innovation, communication, professionalism.

The statistics about the existing computers and the Internet users in Romania are rather few. However, the annual growth rate of the Internet users is quite important, reaching even 23% lately, as shown in Table 2.3.

Tabelul 2.3. Statistics of Romanian Internet users

Year	Users	Population	% Pop	Source
2000	800,000	22,217,700	3.6 %	ITU <sup>2</sup>
2004	4,000,000	21,377,426	18.7 %	ITU
2006	4,940,000	21,266,679	23.2 %	C.I. Almanac <sup>3</sup>

By referring to the main locations (venues) from where the Internet is accessed, we can see that almost half of the answers (47.7%) mentioned their working place and one third (33.6%) mentioned their homes. (See Diagram 2.3).

Other locations are less preferred, being mentioned by smaller percentages: public locations (8.1%) and school/university (8.0%).

Diagrama 2.3. Usual place for accesing Internet

Once we've learned the importance of the Internet for the people using it, it is natural to study what it means this technology to its users, why is the Internet so important.

The results we discovered in this matter certify that the Internet is perceived/considered mainly "an

information, training and education source". (See Diagram 2.4).

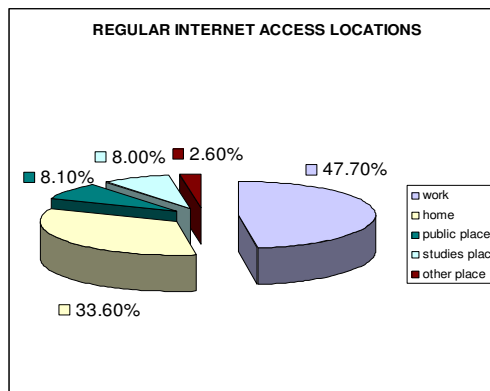


Diagrama 2.4. Internet significance

The study results show that the Internet is mainly used for communication, information and training: "sending/receiving e-mail", "reading news" and "searching information about/for education/studies/training".

Lately the e-learning has developed in Romania, too, and now there are many functional applications.

The computerization of education in Romania keeps on running, using different programs as CES (Computerized Education Systems)<sup>4</sup>, a complementary (not alternative) education system to train teachers and also an educational soft. Its main objective is to support the undergraduate teaching-learning process with the latest technologies. This program supports the education reform, according to the action plan eEurope 2005 started by the European Union and the European initiative for e-learning. The program is implemented by a public-private partnership. The main companies involved in implementing CES are SIVECO Romania, HP and IBM.

The CES program intends to provide access for all participants to the education system, information technology (computers and Internet) by endowing all schools in Romania with complete IT solution for the teaching/ learning process. Thus, every high-school in Romania benefits now by at least one computerized education platform to be used during the lessons of mathematics, biology, physics, chemistry, Romanian, history, etc. A computerized education platform is made up of a set of technology, computers, Internet, electronic multimedia educational content, methodology and training for

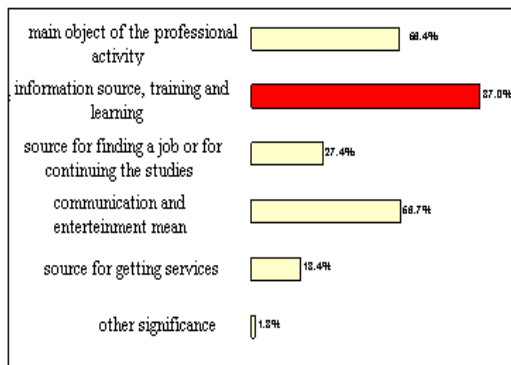
<sup>2</sup> International Telecommunication Union

<sup>3</sup> Computer Industry Almanac

<sup>4</sup> CES was initiated in 2001 by the Group of Promoting Information Technology and the Ministry of Education and Research. It was approved by the Government in 2001 and supported by the companies HP, IBM COMPAQ, SIVECO.

the teachers. At first, the platform was unitary and standardized, but all these platforms integrate in a computerized educational national system.

The CES program also promotes the implementation of information technologies in the educational process through specific educational and administrative projects. This program has many other functions as: school administration, data transfer to the Ministry of Education and Research, educational policy transfer from Ministry to school, inter-school communication, and teacher-pupil-parent communication. To computerize education means to create the infrastructure (as many computers as possible in schools), but also to purchase software products. The mission of this project is also to create



connections between the local communities and the national and international information and transaction systems. The public institutions as schools, town halls, libraries, will be endowed with calculus technique according to the number of pupils and community's needs. The target group is not only the pupils. Beside pupils and teachers, the employees of different public institutions, the public clerks, will be connected to the central database of the Ministry of Administration and Internal Affairs.

The private enterprisers will be connected by virtual systems as market-play type and the villagers will have access not only to communication, but also to the sites purpose-created for them.

The main strategic objectives of this program are:

- society's digital literacy;
- technology (computers and Internet) - support for the education system;
- introducing modern technologies (computer literacy) directly in the teaching process, with pedagogical purpose.

The CES is meant to encourage the innovative education and to stimulate teachers' and pupils' creativity, providing a general favourable background to develop projects and participate in information society development. The CES also contributes to changing the school plan by integrating new methods of teaching and learning.

The CES program provides for its beneficiaries new IT instruments to be used in schools, to increase the quality of the educational system. It is also a substitute for the laboratory instruments and experiments, which are sometimes expensive and even dangerous for those who handle them.

It is important to notice that the main challenge of the CES program is not only the computer distribution, the educational software or the Internet connection, but also the investment in people and their training. The highest risk of this program is not the insufficient number of computers (which is a risk itself), but the computer inappropriate use, or worse, the computer non-use.

Romania showed progress in meeting some training and educational requirements of the European Union, as Romania's participation in the community programs Socrates, Leonardo and Youth, the compatibility of the Romanian education legislation with the community decisions, resolutions and declarations, as those referring to the equal chances for everybody, providing mobility within the high education system, foreign language training, indiscrimination, educational technologies, distance education, continuous training.

From the institutional point of view, many institutions were created in Romania to provide the implementation background for the acquis in education, among which:

- The National Centre for Professional Training Leonardo da Vinci,
- The National Agency Socrates,
- The National Council for Quality Management in the High Education System,
- The National Centre to Develop the Professional and Technical Education.

Nevertheless, the present quality of education needs improvement, and the education institutions should be receptive to the economic and social realities and exigencies, the European problems, the labour market requirements.

The rate of school abandonment is increasing in Romania, the education and professional training system that met the requirement of the state sector does no longer fit the new market requirements, and the public investments in education have been limited for a long period of time. Also Romania lacks a global mechanism to implement the employment policy based on training, while the adults lack the continuous training<sup>5</sup>.

One should not omit the fact that the education institutions in Romania has to run on a competition education market and this requires a higher managerial autonomy of each institution, a flexible normative background and a proper financing, in order to face competition. To be competitive means

<sup>5</sup> National Development Plan 2004-2006

more opening, transparency and competition, a revision of services and marketing culture according to the realities and values of the European education system (as the cultural diversity, the research orientation). An efficient education program also implies the use of an informal education system which:

- maximizes the learning process by minimizing the constraints specific to the formal system;
- provides an immediate practical use for the learned knowledge;
- has a flexible structure;
- is based on the participant's experience;
- allows the learner to evaluate himself during the informal education;
- stimulates inter-human relation development.

The European Union launched many programs and initiatives that made important contributions to education:

- The program Leonardo da Vinci II (2000-2006) – is opened for 30 European countries. This program promotes<sup>6</sup>: the skill and competence development of the young during all levels of the professional training and education process; improving qualities and encouraging the access to permanent training, in order to develop the ability to adapt to the technological and organizational changes; promoting and strengthen the professional training contribution to innovation, in order to increase the sense of competitiveness and enterprising to create new jobs; the cooperation between institutions, including the cooperation between universities and commercial companies.

The project WBT WORLD **Error! Reference source not found.** is financed by the program Leonardo da Vinci. The objective of the project WBT WORLD is to set the premise to improve the quality of the Internet courses at all levels by:

- developing powerful instruments to improve the WBT competences, both technical and pedagogical abilities;
- developing large virtual resource for the WBT formers, where they can learn, share experiences, be informed permanently, etc.

- The main objective of the program Socrates II (2000-2006) is to develop an Europe of knowledge by: strengthening the European dimension of education at all levels; promoting the study of the languages spoken in the EU; supporting cooperation by exchanges between institutions and information exchange; encouraging the distance learning; acknowledging degrees, diplomas and stages abroad.

The program Socrates has the following components:

- COMENIUS – undergraduate education;
- ERASMUS – higher education;
- GRUNDTVIG – adult education;
- LINGUA – learning and teaching foreign languages;
- MINERVA – opened and distance learning;
- Observation & Innovation – education systems and policies (Arion, Naric);
- Joint Actions with other community programs.

ERASMUS is part of the community education program SOCRATES and includes actions to develop the European cooperation in the field of higher education. ERASMUS supports the development of European university and post-university studies and covers all subjects and fields of study.

ERASMUS was launched in 1987 a program meant to support the students while they were studying in another country, with the acknowledgement of the period spent in the partner institution. ERASMUS became a subcomponent of the European Union program SOCRATES in 1995. The general conception and the objectives of the new program have developed, so that mobility is now only one of its objectives for students and teachers. The new program ERASMUS intends to extend the cooperation within the higher education, allowing as many partner institutions as possible to participate in international projects and value the information technologies for the common interest.

At present, ERASMUS provides mobility scholarships for thousand students and insists on the academic acknowledgement of the studies. It is remarkable that in October 2002, the European Committee celebrated the number of 1,000,000 ERASMUS students in Europe.

- The program Youth Tineret II (2000-2006) targets mainly the young people of 15-25 year old. It supports the legal background for the young unconventional activities and promotes the mobility and the intercultural cooperation in the field of education and solidarity for the European youth.

- The communication “Achieving a European space of education and continuous training” (November, 2001) refers to the training and training effect valuation, especially the outside school training.

- The action plan e-Learning (March, 2001) refers to school connection to Internet, infrastructure, training, services, contents, cooperation and dialog.

As the information technologies are widely used, the actual problems in Romania referring to e-learning are technology development and joining the

<sup>6</sup> EU Programs in Romania, How to get finance from the EU, 2003

educational standards on Internet, and on the other hand, their proper application by as many users as possible. The user of the present society (based on knowledge) is any person willing to be trained in a certain field, according to his/ her knowledge degree and cognitive need in a certain context.

To provide the Romanian citizens with access to the new educational systems, it is necessary to: support population's access to Internet; training properly the pupils, students and adults to use efficiently the information resources; financing new research national projects to design and implement such educational systems; initiating teachers to access, use and create scientific and didactic databases on Web, identifying the concept hierarchy for each field of study; promoting and introducing the educational standards in communities (university, manufacturing or business communities).

The most important companies in Romania that provide e-learning platforms/ solutions are:

\* Timsoft provides **Error! Reference source not found.** services for companies, schools, universities or individuals. Examples of online education environments:

- eLearnTS – may be used and configured for online courses – individual or virtual universities, eTraining within companies, online workshops, virtual cooperation space – with Romanian or English variants. It is based on the technologies Perl, MySQL, Java, XML, SOAP; the hosting on Linux server is quite flexible, rapid and secure. The environment models a virtual class with both students' and teacher's participation (facilitator). The facility may be made by more instructors and the course may have invitees or visitors. The interaction between facilitator and participants may be synchronous – through chat – or asynchronous – through conference calls, similar to the discussion forums. The facilitators may give online advice using Live Chat;

- eTestTS is an application for online testing, dynamic questionnaire generation and training modules.

\* Siveco is one of the largest suppliers and integrators of solutions e-Learning, e-Health, e-Business, e-Government software projects [10] in Romania. The training platform assisted by computer is: AEL (Advanced e-Learning). The platform e-learning AeL provides support for teaching and learning, testing and evaluating, content administration, monitoring the education process and curricular conception. AeL may be used in learning with a teacher/ instructor or in independent learning. There are AeL implementations in the undergraduate education and corporation, for internal training need. The AeL system aims at:

- supporting the teaching/ learning process by modern information means, proving teacher with a complementary instrument;
- facilitating the learning process;
- stimulating creativity, competition and teamwork;
- using the simulating software as substitute for the expensive or rare didactic materials.

\* Softwin was established in 1990, as a private company with entire Romanian capital, whose main activity is to supply complex solutions and services in the ICT field. One of the Softwin projects with impact on the Romanian education is the interactive lessons for the high school students. The lessons INTUITEXT settle new standards in the field of computer assisted teaching as interactivity, modularity, multimedia use, a more intuitive learning. The lessons are designed to be used by the teacher in the class, and allow students to follow the teacher's explanations and to interact directly with the study material.

\* SOFTEXPERT developed Expert Learning SYSTEM, an online management program of courses and examinations.

\* Direct Learning Systems provides and develops a series of applications designed to manage human resources:

- Direct Learning System is an e-learning application that allows the training program management. The application is implemented on the site [www.CursuriOnline.ro](http://www.CursuriOnline.ro)

- OnlineExaminer is a testing application that may be used by any computer network with a Windows server. It allows online test management. The application is implemented on the site [www.TestariOnline.ro](http://www.TestariOnline.ro).

\* The e-Learning environment E-LEARNING introduces a new approach in the relation reader-book, namely the interactivity between the user and the presented material. It addresses to: training companies, academic environment, distance learning, companies willing to benefit by electronic presence. The users benefit by interactive and differentiated narration/ explanation.

Romania has made important progress in meeting (fulfilling, complying) some educational and training conditions demanded (asked, requested) by the European Union, such as taking part in communitarian programs Socrates, Leonardo and Youth, adapting the Romanian set of laws in education to the decisions, resolutions and communitarian declarations as the ones regarding the equal chances to all, insuring the mobility in the superior education, education in foreign languages, the use of educational technologies, distance education, continuous formation.



### 3. Determining the efficiency of the teaching-learning multimedia technologies

Within the measuring activity, numbers, i.e. arbitrary values, are assigned to objects or to their respective properties, with the condition that the established measurement rules ensure the viability of the accepted measurement function. Measuring is an indispensable condition for further operations regarding the processing and interpretation the output of the research.

In order for the measuring to observe the validation conditions it is mandatory to determine the characteristics of the phenomena which we intend to measure and to use the most adequate measuring tool. Within educational research we can distinguish several steps of the evaluation:

1. the first step is recording, which consists of detecting the presence or absence of an objective behavioural trait. Within this stage the subjects and their answers are counted, the grades and averages of the same value are counted etc.
2. the second step of the quantitative evaluation is ordering or classifying. It consists of arranging the research objects in an ascending or descending succession. Arranging the parameters based on certain common traits is called the ranking procedure. Arranging the elements of the series is done based on a determined criterion. The place of each element within the series is called its rank, which is attributed a rank number. If the evaluation of the examination performances refers to a test score, the number of points obtained by each student indicates the rank he has within the series, representing the maximum score. "The numbers obtained with the aid of the ranks can serve as benchmarks for the evaluation of the level of knowledge gain"[16].

The experimental implementation and the determination of efficiency for the teaching-learning multimedia technologies intended to support the technologies required by the educational system, to synchronize it with the development general trends of the contemporary society.

The present interest investigations refer to the fact that lately the society have demanded insistently everything connected to computers: training specialists to apply the calculus system by developing the skills to accumulate and understand information, to apply information and communication technologies, to design virtual models of the real objects and actions. The advanced information technologies have contributed to motivation increase to study certain subjects that have nothing to do with the computer science, because they facilitate learning by

considering the student's individual particularities, his/ her preferences and abilities, and provide the feedback between the student and the program [3] below and increase the efficiency of the learning process.

In the research experiment, we have applied the technique of parallel groups which requires the involvement of four groups of second year students, majoring in Finance and Banking, Faculty of Economics Science.

To evaluate the research results (that intend to validate didactic techniques), a test on students' creativity was applied [5] below to two parallel groups: experimental and control groups.

The results are listed in a synthetic table (a grouping of measured data, leaving aside the names of the subjects) where the students' names were replaced by a code that represents the following:

- a) the Roman numbers I, II, ..., XI indicate the number of the subgroup the student belongs;
- b) the letter E indicates that the student belongs to the experimental group, while the C corresponds to the control group;
- c) the Arabic numbers 1, 2, ..., 11, 12 show the student's place on the control lists.

#### 3.1 Applying the Mann-Whitney test ( $U$ )

The Mann-Whitney test ( $U$ ) [4] below may be applied to estimate the differences between two series of data, according to a certain characteristic. According to the application methods, the test may be used to compare the series of limited determined values, according to the ordinal size.

Let's consider two independent series of data

$$\begin{cases} X; x_{11}, x_{12}, \dots, x_{1n} \\ Y; y_{21}, y_{22}, \dots, y_{2m} \end{cases}$$

selected from two independent volume samples  $n$  and  $m$ .

*The null hypothesis  $H_0$*  is the hypothesis of identity distribution. If the variable is continuous, then the identity reflects the equality of averages, medians, etc. In this case, this is a test to compare the average values.

*The alternative hypothesis  $H_1$*  states that the distributions are different between the two populations.

The test statistics is achieved through the following algorithm:

- a) the values  $m+n$  of the two series are taken together and order increasingly;

b) the reunited numbers are given ordered rank values (dealing with the equality cases);

c) the value rank of each sample is then identified:

$$T_1 = \sum R_i \quad \text{for the series } X \text{ and}$$

$$T_2 = \sum R_i \quad \text{for the series } Y$$

d) the quantities are calculated:

$$W_1 = n * m + \frac{n(n+1)}{2} - T_1 \quad \text{și}$$

$$W_2 = n * m + \frac{m(m+1)}{2} - T_2$$

e) the test statistics  $U$  is the minimum value between  $W_1$  and  $W_2$ :  $U = \min(W_1, W_2)$ .

The decision in the test is applied according to the following situations:

- The null hypothesis of identity distribution is rejected, at the settled signification level  $\alpha$  [21] below, if the calculated  $U$  value is smaller or equals the critical table value  $W_{1-\alpha;n;m}$ .
- Otherwise the null hypothesis is not rejected.

The table contains the critical values of the Mann-Whitney test for the sample values smaller than 20, and usual values of  $\alpha$ . For values higher than 20, the normal approximation may be used:

$$W_{1-\alpha;n;m} = \frac{n * m}{2} - z_{1-\alpha/2} \sqrt{\frac{n * m * (n + m + 1)}{12}}$$

meaning to use the expression  $z$  as the test statistics:

$$z = \frac{U - \frac{n * m}{2}}{\sqrt{\frac{n * m * (n + m + 1)}{12}}}$$

The Mann-Whitney test ( $U$ ) regarding the comparison of methods applied for the experimental and control groups is applied as follows:

- *The null hypothesis  $H_0$ :* The marks for the creativity test of the experimental group do not exceed the marks of the control group. In other words, the method applied for the experimental groups does not have a better result compared to the method applied for the control groups, and the difference between the average values are random.

- *The alternative hypothesis  $H_1$ :* The marks for the creativity test of the experimental group exceed the marks of the control group, demonstrating the superiority of the computer assisted learning toward the traditional learning methods. In other words, the methods used for the experimental groups are more efficient than the methods used for the control groups and the differences between the average values are predictable.

To show the efficiency of the methods applied for the experimental groups toward the traditional methods applied for the control groups, I will analyse the data of the creativity test for both groups for 20 students chosen at random.

The data selection for the experimental groups is marked with  $X$ , while the selection for the control groups is marked with  $Y$ . Then both selections are united in a single selection and ordered increasingly. They are assigned ranks as follows: the rank 1 is assigned for the poorest result no matter the group, and the last rank  $N$  ( $n+m$ ) is assigned for the best result no matter the group. If the results are equal, an average of equal ranks is assigned. For examples, if two persons have identical results and occupy the ranks 5 and 6, the rank 7 will written in the table, and the next assigned rank will be 7. If three have the same results and occupy the ranks 9, 10 and 11, the rank 10 will be assigned for all of them, and the next available rank will be 12. This is how I came to the following table (table 3.1):

I made the calculations:

$$T_1 = \sum R_i = 602 \quad \text{for the series } X \text{ and}$$

$$= 219 \quad \text{for the series } Y$$

$n=20, m=20$ , and the quantities are calculated:

$$W_1 = n * m + \frac{n(n+1)}{2} - T_1 = 400 + 210 - 602 = 8$$

$$W_2 = n * m + \frac{m(m+1)}{2} - T_2 = 400 + 210 - 219 = 391$$

The test statistics  $U = \min(W_1, W_2) = 8$ .

The critical table values:  $W_{0,95;20,20} = 127$ . It results  $U < W_{0,95;20,20}$ .

$$T_2 = \sum R_i$$

Tabel 3.1 Selected data for applying Mann-Whitney test for establishing the methodic efficiency applied in the experimental groups, comparative to the traditional method, applied in the control groups regarding the creativity trail

Experimental group			Control group		
<i>Student code</i>	<i>Mark</i>	<i>Rank</i>	<i>Student code</i>	<i>Mark</i>	<i>Rank</i>
IE7	6	13	IC3	4	2
IIE6	6	13	IIC2	4	2
IE5	7	21	IIC6	4	2
IE6	7	21	IC1	5	6,5
IIE2	7	21	IC9	5	6,5
IE2	8	29	IC10	5	6,5
IE3	8	29	IIC3	5	6,5
IE8	8	29	IIC5	5	6,5
IE9	8	29	IIC7	5	6,5
IIE4	8	29	IC2	6	13
IIE8	8	29	IC6	6	13
IE1	9	35	IC7	6	13
IIE1	9	35	IIC1	6	13
IIE5	9	35	IIC8	6	13
IIE9	9	35	IC4	7	21
IIE12	9	35	IC5	7	21
IE4	10	41	IC8	7	21
IE10	10	41	IIC4	7	21
IIE10	10	41	IIC11	8	29
IIE11	10	41	IIC12	10	41
Suma	166	602	Suma	107	219

Decision in test: As the calculated value is smaller than the critical values, the null hypothesis H0 may be rejected and the H1 hypothesis is checked.

H1: The marks for the creativity test of the experimental group exceed the marks of the control group, demonstrating the superiority of the computer assisted learning toward the traditional learning methods. In other words, the methods used for the experimental groups are more efficient than the methods used for the control groups and the differences between the average values are predictable. The results prove the difference between the applied methods.

Based on the criteria used and the verified hypotheses, we can state the following, in conclusion:

→ the overall analysis of the mathematical and statistical evaluations indicates a satisfactory progress for the students in all the groups involved in the research experiment;

→ applying the elaborated methodology contributes to the amplification of the efficiency of the teaching-learning process and offers training possibilities that take into consideration the individual characteristics of every student;

→ the implementation of multimedia courses contributes to information assimilation, by applying knowledge in the creative process

→ computer assisted training has as a result an increase in the quality of data acquisition.

→ by applying the multimedia courses in the process of teaching-learning all subject matters, we amplify the interest of the students towards the respective subject matters.

The research in question has tried to propose a new perspective for performing the learning-teaching process, corresponding to present requirements, which, by using information technology, offers new possibilities to stimulate interest, new ways for active involvement of the student in the knowledge process.

#### 4. Implementing an application to manage the distance learning students' activities

This chapter provides a solution to improve and make efficient the management of students from a faculty, using the Web technologies. The application is divided into 5 modules:

- the public module provides a series of information regarding the distance learning (the profiles of each faculty, how to register, the admittance methodology, the educational offer);

- the administrator module provides the necessary functions to manage the organizational chart of the university and the account management;

- the secretariat module provides the necessary functions to manage the organizational chart of the

profiles, as well as the necessary functions to manage students' activities;

- the teacher module provides the necessary functions to manage the organizational chart of courses, laboratories and examinations, as well as the necessary functions to manage students' activities;

- the student module offer the students the possibilities to get note books and courses, information regarding the activity during the courses, or to discuss with their colleagues and tutors through chat or e-mail.

The entire application took into account:

- avoiding the use of files that consume a large amount of memory;
- using some software that do not need to purchase the licence;
- using some software that run on computers of modest performances.

From the logical structure point of view, the modules listed above communicate unidirectional, as figure 4.1 shows.

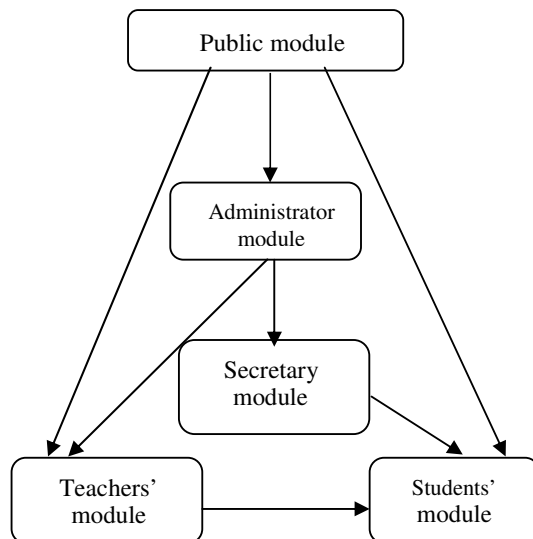


Fig.4.1 The logical structure of the application

The main objective of this system is to develop an easy-to-use environment for both students and teachers. The success of this application depends on the teacher's availability to fill this system with quality educational content and a set of questions relevant in number and content. Through this system, the teachers offer their students digital units to study and self evaluation questions.

**The public module** provides information regarding the educational, the admittance methodology and the user's guide. The model also provides information regarding the faculties that run within the university, the profiles of each faculty and the number of positions, the tuition and what to do to become a student.

This module offers information regarding the education plan of each profile for each university year, the students registered for distance learning and their school records. All events of the university the students and teachers may participate in (conferences, seminars) may be found here. If a student does not access the pages of educational resources for 30 consecutive days, then he/ she will receive an e-mail that he/ she has to participate in the educational process, when a user of the public module access it.

**The administrator module.** The functions offered by the administration module are very important, because the other modules and functions depend on them. The functions of the administration module may be grouped into the following categories: functions necessary to the organizational chart of the university: faculty updates, profile updates, teacher update; functions necessary to account management: updating the administrator's personal account, updating the teachers' and secretaries' accounts; functions necessary to communicate: forum administration. The administration panel of the forum is the place where most configurations are made. The administrator controls here the forum and category organization, and may configure the forum names and self cleaning settings.

The administrator having an account for the application may introduce in a form the account name and password, and when clicking OK the application will check if there is such an account and password. According to the testing results made by the application, the administrator will be allowed to access the functions of the respective module corresponding to his/ her account, otherwise an error message will be displayed.

I will choose the operation of profile update to exemplify this. The administrator is allowed to do the following operations:

- list the existing profiles;
- add new profiles;
- change a profile;
- delete a profile;
- update secretary account.



Fig. 4.2 Administrator Module – Listing the existing faculties

The secretariat module offers the necessary functions to manage the profile organizational structure, as well as the necessary functions to manage students’ activities (update university and study years, update students, update educational plans).

The functions of the secretariat module are important because the entire education process depends on them. This level settles the following record stages of the education process:

- the curricular area on faculties, profiles, calendar and study years. The education plan means to establish the subjects for each study year, to specify the credit points, the verification form (examination or preliminary examination), the semester each subject is thought, the titular professor and the tutor.
  - the number of promoted examinations are calculated;
  - the number of behind examinations is determined;
  - the number of credit points is calculated;
  - the average promotion mark of the study year is calculated.
- the record of students on faculties, profiles, calendar and study years. In order to transfer the data correctly from one calendar year to another, the secretary has to open the page “School records” and automatically each student’s data updates in the table tbl\_calculstud as follows:
  - students in alphabetical order;
- the centralizing books on faculties, profiles, calendar and study years. This option is useful for the secretary to see the students’ results and to list the results.
- the Registration Book on faculties, profiles, calendar and study years.
- statistical reporting upon request on faculties, profiles, calendar and study years. These data may be visualize according to the following selection criteria:
  - students ordered decreasingly by their average mark;
  - students listed on groups (study formations);
  - students by name (this option is useful for those who know the distance learning students as: parents, colleagues, friends).

- students ordered decreasingly by their average mark;
- students listed on groups (study formations);
- students by name (this option is useful for those who know the distance learning students as: parents, colleagues, friends).

The secretary of a faculty has an account created by the application administrator. With his/ her account name and password, the secretary may access only the web page he/ she is in charge and perform all specific secretarial operations.

Faculty of Economics Sciences					
University year : 2005-2006					
MARK REGISTER					
Accounting and Informatics of Gestion					
First year, first semester					
Object: Macroeconomy					
Semester: First semester					
Credit points: 7					
Verification: exam					
Professor: prof.dr. Pana Ion					
Tutor: prof.dr. Pana Ioan					
Nr. Crt.	First Name and Last Name	Mark		Date	Signature
		cifre	litere		
1	A.A.A	7	sapte	19.02.2005	
3	B.B.B	5	cinci	19.02.2005	
		7	sapte	23.06.2006	
4	C.C.C	A	Absent	19.02.2006	
		5	cinci	23.06.2006	
5	D.D.D	A	Absent	19.02.2006	
		4	patru	23.06.2006	
Decan: prof.univ.dr. Barbu Nicolae					

Fig. 4.3 – Secretary Modulul – Listing the marks register

For example, the secretary of a certain profile may visualize the students' marks on groups and subjects. The page Class Register Book offers the secretary a useful method to make records, mark students according to the university year, study year or group they belong to.

The secretary may print the Class Register Books and save them in a document, in order to save the information on paper, too. The data are taken from the table `tbl_notecompletate` and sent automatically in a document by selecting the option "Print the Class Register Book".

**The teacher module** provides the necessary functions to manage the course organizational structure (structuring the course on chapters), the notices regarding the examination dates, the evaluation forms, as well as the necessary functions to manage the students' activity. This module also provides the communication with the students through chat or e-mail.

The functions provided by the teacher module are grouped into the following categories:

- the necessary functions to manage the course organizational structure: transmitting the course materials, presenting the chapters, updating the virtual laboratories;
- the necessary functions to examine the students: establishing the evaluation means, establishing the chapters for the online tests, updating the evaluation cards;
- the necessary functions to manage the students' activities during courses: marking the students at the examinations.

For example, I will show how the Class Registration Book is filled in automatically. The teacher may fill in the Class Registration Books according to the marks of the online tests, during the exam sessions, behind sessions and mark improvement sessions. The teacher has to fill in the date of examination, the number of marks, and the shares of each mark.

Date1	08/28/2006	Date2	09/20/2006
Percentage1	40	Percentage2	60
Nr. Crt.	Name		
1.	A.A.A		
2.	B.B.B		
3.	C.C.C		
4.	D.D.D		

Generate catalogue

Fig. 4.4 – Teachers' Module – Automatic filling in the marks register

When clicking the command button "Generate Class Registration Book", the marks will be taken from the table `tbl_note` according to date and students. For the first examination, the all students will be listed, and if they do not perform the online test, they will be listed as absentees. For another examination, the Class Registration Book will be listed automatically and show only the students behind or those that solicit the mark improvement.

Nr. Crt.	Name	Mark	Date	Enlarge Mark
1	A.A.A	8	25.02.2006	<input type="checkbox"/>
2	B.B.B	Absent	25.02.2006	

Automatic filling in the marks register

Print Mark Register

Fig. 4.5 – Teachers' module - Filled marks register with the students' grades

The titular professor of the course or the tutor has to offer the distance learning students the necessary material to learn each subject. Every tutor has an account name and password established by the administrator. Therefore he/ she may perform all necessary operations to run the education process. A teacher may access only the pages of the subjects he/ she teaches for a certain profile, according to the education plan.

**The student module** offers the students the possibility to acquire note books and courses, information regarding the activity during the present courses, self evaluating tests for each

chapter of the course, or to discuss with their colleagues and tutors through chat or e-mail and see the project topic they have to do, as well as the structure of the group they are part of. The student module offers to a student (who has an account for the application) the following functions:

- the possibility to access all course materials for all the subjects studied in the respective semester;
- chapter presentations for each subject;
- the possibility to access the virtual an online laboratories (for certain subjects);
- online testing and self testing for each chapter;
- listing the final marks for each subject of the current semester;
- filling in the project evaluation cards;
- communicating with their colleagues and subject tutor.

For those subjects provided with laboratories in the traditional education, the distance learning student

may have access to virtual laboratories. The student may access the presentations in specialized programs (WinkPortable – for the computer science laboratories, LabView – for the physics laboratories) and files in .pdf format that contains images with presentations and that may be saved in the personal computer.

For example, for a computer science laboratory made with the application, the student will get the following presentation as figure 4.6 shows.

There are buttons to move from one page to another within the presentation and a navigation bar for the video that allow to run faster or to stop at different moments, or just run the video back and forward.

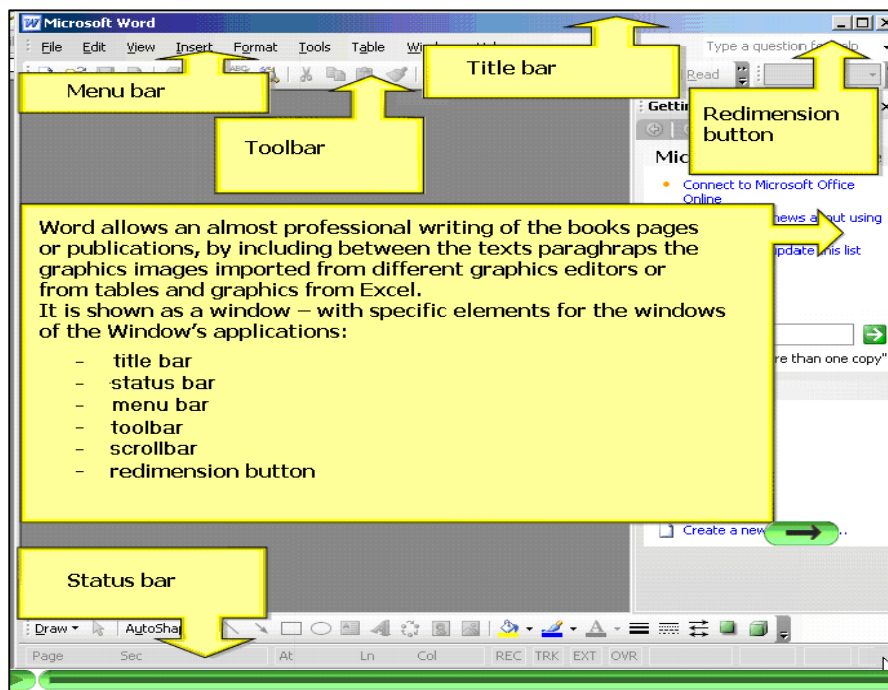


Fig. 4.6 Students' module –Presenting a lesson of creating a Word window

**Conclusions**

The statistical methods applied to process the experimental data confirmed the hypothesis about the positive impact (influence) of multimedia course implementation in the teaching-learning process for the experimental groups and the efficiency of the methods applied to the experimental groups, toward the traditional methods applied to the control groups.

Considering the heterogeneous elements of the statistical population, the conclusion is statistic only for the elements involved in the experiment. For other elements, the conclusion is applicable only through analogy.

We presented the data processing by some statistical tests, applied in evaluating the results of the pedagogical experiment. According to the criteria I used and the hypothesis I checked, I may conclude that:

- the general analysis of the statistical and mathematical evaluations indicate a satisfactory

progress for all the students involved in the research experiment;

- the methods applied contribute to increasing the efficiency of the teaching-learning process and provide learning possibility according to the each students' individual particularities;
- the multimedia course implementation contributes to information learning, by applying knowledge in the creation process;
- the computer assisted learning generates the learning quality increase;
- the multimedia courses applied in the teaching-learning process of all subjects increases students' interest toward the respective subjects.

This study tried to propose a new perspective of the teaching-learning process, according to the presented exigencies. The use of information technologies provides new possibilities to stimulate the interest and new ways to involve the student in the knowledge process.

The implemented electronic platform has a opened and adaptive structure that contains the following interaction components:

- the administration component;
- the educational component;
- the communication component.

The administration component is very important and contains:

- user administration;
- educational component administration (secretariat);
- discussion forum administration.

The educational component allows the educational material to be created online and offline. The management of the educational component is very important and contains:

- The course management: course making, adding, changing and deleting chapters, course visualising;
- The test and project management: adding, changing and deleting certain questions in the test or evaluation cards, updating the project topics. Every test will contain a set of questions established by the teacher; the questions are chosen at random from the set of questions of each chapter.
- The virtual laboratory management: with specialized software for each course.

The communication component includes a discussion forum, students' update, e-mail and chat communication with the tutors. The designed platform e-learning is an integrated teaching, learning and content management system based on modern educational principles. The platform e-learning provides support to teach and learn, test and evaluation, content administration, education monitoring and curricular conception. Therefore it offers the student the possibility to access the curricula (didactic material) anytime and anywhere, thus developing mobility and facility for the theoretical activity. Through this platform, the students may have online examinations, receive the feedback for his/ her results, or monitor his/ her performance in his/ her personal page.

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