New Paradigms in Artificial Intelligence.

The Experience of a Romanian Project

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Abstract: The paper brings forward the Romanian master program ITEMS (Techniques for Analysis, Modelling and Simulation for Imaging, Bioinformatics and Complex Systems) which has been conceived as a research master at the confluence of information technology (hard / soft) with domains having an exponential development: imaging, bioinformatics, and complex systems, the progress of which has had a tremendous impact scientifically, technologically and socially.
The paper focuses on the fact that nowadays, the information society in which we live needs wider educational spaces, and the internet provides a powerful tool to introduce new educational technologies and to use online applications. It is shown that the technologies for informatics and communication provide a very positive aid to the learning tasks. Interactive tutorials allow access to a big amount of information in a multi-sequential way.

Key Words: information society, bioinformatics, simulation for imaging, technology transfer, complex systems, curriculum, analysis, processing, coding

1 Introduction

Education is a dynamic and complex area and the new reforms initiated by the Romanian Ministry of Education, Research, Youth and Sport prove that the importance of the technical higher education has been increasing year by year. This increase is an important factor in the development of new educational techniques. To begin with, we specify that in the domain of the technical higher education the main aims are the creation of the institutional autonomy of universities from a financial, didactic and human resources point of view and especially the promotion of this autonomy as regards the defining of local curriculum. We can also mention the complete self-management of extra-budgetary resources by the educational units; the drawing up of programs for the managerial training as part of the basic training of the teaching staff; the promoting of the contractual relation in partnerships between the education units and their social partners that are interested in the educational domain; the promoting

of postgraduate training and the reorganization of its financing.

A concrete example is the master program ITEMS (Techniques for Analysis, Modelling and Simulation for Imaging, Bioinformatics and Complex Systems) which has been conceived as a research master at the confluence of information technology (hard / soft) with domains with an exponential development: imaging, bioinformatics, and complex systems the progress of which has had a tremendous impact scientifically, technologically and socially.

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2 Science and Technology

The master program ITEMS has four terms (the last being entirely dedicated to elaborating the master thesis either in a laboratory of one of the partners – University POLITEHNICA of Bucharest, University of Oradea, University *Transilvania* of Braşov or in a laboratory

abroad in U.E. or U.S.A.) and a four weeks *summer school*.

This master program aims to provide a solid and modern theoretical and practical basis – at the level of renowned foreign masters – to future design engineers and/or scientists. Most graduates will continue their training with the doctoral program. From this fundamental objective the secondary objectives on course selection have derived; in particular, in the first term, the training in mathematics and physics is resumed in a modern version similar to that used in famous universities abroad.

A second objective of the project is to develop a program attractive to students from all over Europe – that is, the evolution of the master towards a European Master – and the creation of a European center of excellence in the directions of modelling and simulation, and data analysis systems.

In accordance with the fundamental objective, graduates of the masters program will have the necessary skills of a design engineer and of a young researcher: the ability to identify and analyse problems of modelling, simulation, design, transmission, storage, etc. in various practical applications in these areas.

The first three terms (of 14 weeks each) will comprise each 6 courses with school hours of teaching and applications (workshop / laboratory / project) and hours of supervised research (which will serve to both deepen and extrapolate the taught topics). A 4-week summer school (between the two years) will also be an opportunity to broaden the scientific and technical horizon of the student. Courses will be organized in modules and each module will have a separate teacher.

3 The Curriculum as a Whole

In order to foster such an interdisciplinary cooperation, it was necessary that the curricula and the plans of study should be mapped out by the national departmental commissions which are coordinated by the National Council for the Curriculum (NCC).

NCC made the curricula; it ensured their vertical and horizontal coherence and submitted them to the Ministry of Education for approval.

The process of revising the curricula, of consultations and of approval comprises a sequence of stages, as such:
- the selection of the model of curriculum following the consulting of experts;
- the revising of the curriculum drafts by the national departmental commissions and their forwarding, accompanied by a report, to the Commission of Experts of the National Council for the Curriculum;
- the consulting of those interested in the curriculum drafts;

- the centralization of the suggestions made during the consultations, a process carried out by the members of the Commissions for coordination of the NCC (these are commissions that coordinate the activity of the national departmental commissions by regrouping them on curricular areas);
- the communication of these suggestions to the commission of experts (CE) of the NCC.
- the discussing of possible changes to be brought to the curricula from the perspective of the suggestions that have been made and the analysis of the vertical and horizontal correlations;
- the sanctioning of the appropriate curricula by the executive board of the NCC
- the drafting of the sanctioning documents and the sanctioning of the curricula by Order of Minister

The National Curriculum includes the reference points , the criteria and the principles underlying the revising of the new curricula. These are as follows:
- the reference to the dynamics and current necessities as well as to the projected aims of the Romanian educational system, which are generated by the evolution of society and are specified in official documents of educational policy.
- the reference to the current tendencies and the generally accepted international criteria in the domain of curricular reforms.
- the reference to those traditions of the Romanian educational system that are relevant from the point of view of the ongoing reform.

In this context, the principles regarding the curriculum as a whole are important:
− The curriculum must reflect the educational level of the Romanian technical high school as defined by the Education Act.
− The curriculum must reflect the dynamics of the social and cultural values that are characteristic for an open and democratic society.
− The curriculum must stimulate the development of critical and creative thinking.
− The curriculum must help the students discover their gifts and make the best of them to their own benefit and that of the whole society.

In Romanian higher education (including scientific research in universities and international cooperation) curricular reforms have been adopted in universities through the operation of the short-time higher education (university colleges); the continuation of study in university colleges of graduates from post-high school colleges; the regulations for entrance examinations in colleges and faculties; the graduating of study in short and long-time higher education; the organization and unfolding of master's and doctoral programs; the complete university education given in foreign

languages; the organization and operation of long-distance education in universities; criteria for evaluating the strategic plan for the institutional development of state universities; the change of the Regulation on which the activity of the National Council for Academic Evaluation is based; the approval of the methodological norms for the evaluation of the professional performance of the university teaching staff; the authorization for provisional functioning and the accreditation of various fields of study in the private and state higher education; formula-funding for core financing of higher education.

4 Teaching and Learning Strategies

The results obtained within the master program *Techniques for Analysis, Modeling and Simulation for Imaging, Bioinformatics and Complex Systems* pose the question: which are the methods used for strengthening the correlation between education and learning and for encouraging the active participation of the learners?

The answer is not simple but the educational system in Romania - just like the other European systems - is facing some general requirements whose direction is imposed by the educational, the economic and the social, development, both at a national and international level.[8]

The Romanian National Curriculum was revised taking into account the expectations that society had in these conditions from higher technical universities during the educational and learning process.

In the documents of the Romanian Ministry of Education, Research, Youth and Sport, (the *Reference framework* of the National Curriculum for compulsory education) these exigencies are summarized as follows:

– The aptitude for thinking critically and divergently which is likely to help the students make good use in different circumstances of the knowledge and skills they have acquired;

– The motivation and capacity to positively react to change, as a premise of personal development;

– The aptitude for active social integration, combined with a set of personalized attitudes and values, that will enable the graduates to participate in the life of an open and democratic society.

For attaining the goals of Romanian educational system, the educational process has become a compulsory curricular orientation and consequently the application of certain teaching and learning strategies and of certain methods that should accomplish this aim has become equally impending. We are going to see how this component is reflected by the educational theory and practice in Romania using the recent example of the master to which we have referred. The objectives and

the results achieved within the master *Techniques for Analysis, Modelling and Simulation for Imaging, Bioinformatics and Complex Systems* reflect the fact that education is student-centred , that the curricular areas which include a core of compulsory subjects, besides a range of elective ones, have been reshaped in order to allow as personal as possible educational routes, through a varied offer of electives of all types (subject-centred, curricular area-centred). This had the aim of developing the students' critical thought , their capacity to solve problems alone, to communicate in their mother tongue or in a foreign language, to use informational technology, etc. in order that universities should offer individual educational routes.

Within the master program ITEMS, the research domains comprise several fields. For example, in the domain *Imaging* what is followed is: analysis, processing, coding, acquisition, data compression and transmission for still images or for 2D and 3D image sequences, content-based image retrieval, study of the mechanisms of image perception and visual world, applications.

Bioinformatics focuses on an area that encompasses much more than medical or biological imaging (microscopic analysis) – contributes to the progress of genetics and cell biology.

Complex systems which comprise computer networks highlight systems that cannot be described in terms of mere (determinist) description of its elements or subsystems, because of the too large number of elements; an appropriate description of such systems can be done using probabilistic (statistic) models and nonlinear models.

The complexity of the issues raised in a various branch of knowledge research like the present one emphasizes the fact that the syllabuses for all levels and for all types of technical universities, also include - explicitly - strategic elements that are meant to serve the goal of forming a new educational profile of the student. Thus, at the level of each curricular area, the objectives and the strategic and methodological dominants of the curriculum are centred both around the interests of the society and around the interests of the beneficiary of the educational activity, the student with its needs. Rendering the contents flexible and adapting them to the concrete level of development of the pupils have to be constantly pursued, the emphasis being on procedural learning, on the students' structuring of their own strategies and procedures of solving the problems, of exploring and investigating them. These orientations have materialized, on the one hand, in the manner in which contents have been organized, and, on the other hand, in the types of activities that are meant to be carried on together with the students for attaining the curricular goals.[4]

The bibliography has been reshaped in order to offer the students and the teachers modern applied methodologies, with learning activities centred on individual and group work and differentiated learning tasks. Of course that both the syllabuses and, particularly, the textbooks that they generated can still be improved as regards the amount of knowledge suggested to be acquired. [3]

Among the didactic methods mentioned in the syllabuses the most important ones might be those leading to a new type of communication between the teacher and the student and among students during classes, thus developing the team spirit and cooperation among the members of the group. The method of the project and the requirement of making individual folders - the use of which has been generalized lately in the didactic documents and strategies and which are gradually becoming a common practice in class - are introducing a new kind of individual and/or group activity of the students, emphasizing the development of the originality, creativity and independence of the students in carrying out certain coherent learning tasks.

In order to answer the challenges of the future, the Romanian teacher will have to become a facilitator of the learning process, encouraging individual development and increasing the opportunities of the student for group and self-study. Besides the planning activities, he will have to organize the group involved in the learning and researching process and become flexible enough to be able to face unforeseen and even temporary situations of conflict. The teacher will have the opportunity to go beyond the narrow, protected framework of the classroom and start to work together with his colleagues. An integrated curricular approach, which is gradually built and results from cooperation during work and from a team spirit will facilitate the introduction and acquisition more and more easily transferable.[7]

In order to apply the formal curriculum, an important role must be played by teacher training.

Besides restructuring the initial training programs offered by the Universities, a central role in the Reform of the Romanian education is played by the continuous training of the teaching staff. The two major directions in the restructuring of teacher training have been, during the last two years, the decentralizing of the training offer and the increase in its quality.

According to the evaluations training has not managed so far to include a sufficient number of teachers and has not yet attained its goal of essential innovative factor in the successful application of the reform.

The modernization of Romanian technical higher education will become convincing when the reform will materialize in the change of the didactic approach in class. This process of modernization will have to materialize in the formal curricular innovation (planning, syllabuses), elective textbooks, educational tools, the generalized access to the informational system and the new modalities of information that represent new quality supports in the coherent application of certain new didactic methods and strategies for which teachers need to be trained. A coherent policy of continuous training will finally impose a real and complete reform in the Romanian educational system.

5 Brain-gain or Brain-drain

Regarding the master program ITEMS (Techniques for Analysis, Modelling and Simulation for Imaging, Bioinformatics and Complex Systems) the cooperation with universities and foreign research centers will benefit from new applications and platforms and an *infrastructure made out of high performance computing equipments* (parallel computer – Blue Gene eServer type Supercomputer – Gigabit Ethernet cluster of computers) visualization solutions (stereo display wall), specialized software for modelling, simulation and visualization.

The program also benefits from collaborations with research groups from CNRS and Genopole, Institute for Neuro and Bioinformatik, University of Luebeck and Boyce Thompson Institute and Cornell University.

As professor Vasile Buzuloiu has stated, the innovation is a part of mobility, and mobility is an engine running innovation. On the recurring question of brain-gain or brain-drain, if it is done properly it is a gain all-round. Mobility need not just exist between sectors and countries, but can be fruitful between universities and business communities. Universities do not know validation of results as businesses – the exchange between the two was successful in getting results from the research centre to the provider – opposite to the flow of knowledge/teaching from university to business. Didactic and organizational changes in universities will not be possible without systemic changes. The joining of ICT and education requires organizational changes on the level of the whole system, thus changing the attitude towards time, place, curriculum and other connected attributes.[1]

The ICT revolution is a revolution changing all modes and patterns of our lives and hence bound to lead to dramatic changes in education. It is characterized by its recognition of two basic facts:

• ICT has a powerful defining impact on all important aspects of our lives

• The ICT revolution is a part of a group of intertwined revolutions that in the past twenty years have been transforming the culture from a modern into a postmodern one.

Information and communication technologies is about digital information passing between devices. ICT development has changed every aspect to the human society. It has affected our life in many ways. The Impact of ICT on Society can be ascertained in various ways:

- Faster communication speed, with the capability of bandwidth, broadband and connection speed on the internet, any information can travel fast at an instant. It saves time and is inexpensive.
- Lower Communication Speed. Using the internet is cost-effective than the other mode of communication such as telephone or mailing. It allows people to have access to large amounts of data at a very low cost.
- Paperless environment. ICT technology has created the term paperless environment. This term means information can be stored and retrieved through the digital medium instead of paper. Online communication via email, online chat and instant messages also helps in creating the paperless environment.
- Effective Sharing of Information. People can share and exchange opinions, news and information through discussion groups, mailing list and forums on the internet. This enable knowledge sharing which will contribute to the development of a knowledge based society.

6 Conclusions

The most important achievements of the master program referred to so far and, more generally, of the reform of education are those in the domain of the curriculum, of the infrastructure and of the connection to the great information channels, of the interaction between the education institutions and community, of academic management and of international cooperation.

The problems which are most difficult to overcome are those originating in the inauspicious social and economic context which has resulted in the decrease in the standards of living of the population and in the interest in education. This has led to a growth in the number of competent people emigrating to other country, as the number of diploma holding unemployed people is growing. Therefore, one of the difficulties that has required and still require sustained efforts is the building up of a coherent legal framework that should not be submitted any more to often conflicting initiatives.[9] The identification of the blank spots of education and the clear definition of the legal framework of education represent premises of a fluent functioning of the education system.

Also, a major problem of any contemporary reform of education is represented by the organization of the educational offer so as to match the diversification of the educational demands of students in the circumstances of growing financial difficulties. The solution of organizing and reforming education from the perspective of permanent education appears to be a realistic one as it allows for the creation of certain flexible bridges between levels and routes of education.

A real reform of education has as a major aim the development of the free and creative personality, its social function being integration in social order and change. Such a reform starts from reality and from traditions, secures equal chances of access to and success in education, answers the challenges of contemporary world, of the new economies, based on computer technologies of communication, on knowledge and creativity, changes consumerist mentalities into creative attitudes.[2]

A challenge comes from the difficulty of achieving at the same time and to the same extent an equality of chances at the highest qualitative level of education. Another comes from the processes of globalization and integration and refers to the preserving of national identity and dignity, the developing of national heritage, the assertion of the national creative spirit.

The reform of education will have to take into account: the major aims of the social, economic, political project, the needs and aspirations of young people, the cultural and pedagogical level of society, the resources of the system, the adherence of social agents to change, the succession of stages in the logic of the reform.

The reforms in education must be a step in front of the economic ones - without being isolated from them - in order to develop the tendencies of stability and economic growth. If the revival of economic growth is a condition of a lasting social and educational development, the success of the education reform is a premise for the macro-structural economic reforms that primarily aim at the development of certain sectors (tertiary - from the sphere of services, health, education) new professions and jobs, new attitudes towards performance, competition, merit, risk, the new social middle class that encourages economic, social and political pluralism.

Changes in education will be submitted to a triple impact: cultural traditions, the current problems of the world, the problems of the future.

The reforms of education, by extending the duration of compulsory education, encourage the democratization of society as they reduce the dependence of the social position of a person on his/her social origin.

From this perspective, the priorities of educational reforms seem to be:

- the securing of equal chances of getting education,
- the improvement of the quality of education,
- the assertion of the organizing principle of continuous education - at all ages and along all alternative educational routes (formal, non-formal and informal).

If education does not succeed as a factor increasing professionalism and stimulating the freedom of creation, then the costs will be higher as we will have to spend more on public services or the social protection of those who are not easily adaptable to social and professional and cultural integration.[6]

The problem of striking a balance between the demand for social and professional training and the educational offer will be solved both by prognoses about the labour force market and, mainly, by training extremely adaptable graduates (multiple skills).[5]

The current trend in educational reform must be preserved and adjusted on the way, so that the process of European integration be a constant attribute of this approach. In this context, the coordinates of future efforts might be:

- securing the equality of access to education and, mainly, doing away with the discrepancies between the urban and rural environments;
- securing the equality of chances of getting education by a judicious organization of the education network, by a pluralist educational offer;
- eliminating the difficulties created by the inappropriate quality of economic infrastructure and local services, by the insufficiency and non-uniform distribution of funds, by the quality of the equipment and human resources;
- compensating the disadvantages created by the social and economic context in which the educational system operates, by legislative and administrative measures aiming at reducing the phenomenon of dropping out from school and at restoring confidence and interest in the social and professional success through education;
- becoming part of the European Higher Education Area;
- realization of lifelong learning for all, with the increased role of ICT.

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