EVALUATION OF PROFESSIONAL DEVELOPMENT IN THE MECHANICAL ENGINEERING FIELD BASED ON ECONOMICAL EDUCATION

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Abstract*: In this paper is presented the evaluation framework of professional development in the mechanical engineering field oriented on economical education (Metrology, Quality Control and Organization Logistics) realized under the project „Filière Euro Qualité Logistique des Organisations", acronym EURO-QLIO. The project ensures the quality of the education process and is responding to the work market internationalization through the transversal competences, fulfilled by of international partnership development, educational process internationalization and virtual campus implementation. Thus the educational platform is based on two important components, namely: establishment of a virtual campus and issuance of a diploma with triple recognition. The partnership is ensured by the involvement of three universities: "Henri Poincaré" University of Nancy, France, the project coordinator, "Politehnica" University of Bucharest", Romania, and "Angel Kanchev" of Rouse, Bulgaria. As interface with the industry in the EURO-QLIO consortium is "SC Marco & Alex Instalaţii Frig SRL" Enterprise.*

1. INTRODUCTION

Diversity is the foundation of mutual learning system and in the same time a challenge for defining quality transparency of the education and professional development systems. Academical system for professional education and development in the mechanical engineering field covers a a diversity of programmes which lead to a wide area of qualifications and competencies. This extremely important aspect leads to a growing mutual trust and mobility support. ERASMUS project, code 134395-LLP-1-2007-1-FR-ERASMUS-EVC entitled „Filière Euro Qualité Logistique des Organisations", acronym EURO – QLIO, was created to support this effort of creating a virtual campus by using certain instruments and devices of the Communicatuon and Information Technology at an European level (TICE). The project`s target is creating long distance platforms of education and multimedia modules for establishing a long distance mixt pedagogy on a colaboration platform and by being present by establishing group meetings. The formations` assembly shall be coordinated by pedagogical teams constituted of university professors from three different countries: France, Romania and Bulgaria.

This article presents evaluation methods for measuring the competencies implemented by EURO – QLIO project. Establishing a new specialization on the border between engineering and economy based on organizational quality an logistics elements. Quality is „the ensemble of characteristics of an entity, which confers it the ability of

satisfying the expressed or implicit needs" [SR ISO 8402:1995]. A similar definition is given by ISO standard 9000:2000 which defines quality as „the apportion of an intrinsic characteristics ensemble in fulfilling the requests/needs". Quality is characterized by: not being self stagnant, it exists only in relation to the beneficiary`s needs; it epresses itself through an esemble of characteristocs; is a continuous variable and not discreet; it must satisfy not only the expressed needs but also the implicit ones.

Due to the fact that quality can be seen from different points of view, we intend to attract specialists from different engineering fields: freezing technique, termical energy production, internal aeration machines, machine organs, biomechanics and mecatronics, to approach quality into a stable specialization. This shall be ensured by collaborating with specialists from France (Henry Poincare University) and specialists from Bulgaria (Anghel Kancev University) members of the said project. As any mechanical engineering specialization should be deeply anchored in the industrial life in order to ensure the interface between the participant universities and industry, specialists from Marco & Alex Instalații Frig Company shall take part at the consortium of the EURO-QLIO programme. The evaluatiuon and re-evaluation process of this specialization is a continuous process and therefore we intend to attract as many new industrial partners as possible.

2. BRIEF PRESENTATION OF EURO-QLIO PROJECT

In February 2006, on the initiative of the Head of Metrology, Control and Quality, Mr. Prof. Dr. Ing. Jean-Philippe Jehl and Ass.Prof. dr.ing. Poubady Ramany Bala, Department responsible of the mission, both on behalf of Henri Poincaré University, Nancy I, together with Prof. dr.ing. Gheorghe Popescu on behalf of Politehnica University of Bucharest established to develop the already exiting Partnership claboration between the two universities in order to formatting specialists in the Metrology,Control and Quality field with a diploma bilaterally accredited.

The projects is based on the new paradigm of the informational society by integrating the objectives of long-term development such as: equal chances, social justice, ecological protection, freedom of movement, cultural diversity and inovative development, reorganization of industry and business environment. By aplying these dezideratums we shall create a new waive for developing human civilisation based on wide access to information, by creating a new working manner, evaluation/exploitation of knowledge therefore amplifying the economical globalization and growing social cohesion. The project`s technical support is based on the convergency of three sectors: technology of information and communication and production of digital content.

The EURO-QLIO project is part of the "eEurope – An informational society for everyone" initiative, appreciated to be a new political direction, which guarantees the next generations of the European Union (EU) to fully take advantage of the evolutions provided by the informational society. „eEurope - An informational society for everyone" was presented on the special reunion of the Extraordinary European Council of the European Community from Lisbone which took place on March 23rd-24th 2000 and was adopted as an action plan (Feira, 2000), and actualized in 2002, at Seville through the strategic document "eEurope2005 - An informational society for everyone". By initiating "eEurope" project EU has established a strategic objective until 2010 intending to become the most competitive and the most dinamic economy based on world knowledge, capable to ensure a sustained economical development/growth, by providing new and better jobs and with the best social cohesion" (Europe`s Council, Lisbon, March 2000) by implementing digital technologies in Europe and by establishing and ensuring all the necessary competencies for using them on a large scale.

This project is intended to create a new virtual universitary campus oriented on a complete formation cycle: licence, masters and doctorate. After passing through different studying levels, the obtained diplomas are to be accredited by partners (double or triple accredited diplomas). Thus all specific features of education on national level are removed by a virtual mobility ensured by participating students and professors. It is obvious that all these shall lead to the integration of software systems inside all education systems of all parteners of this project. The virtual campus integrates a strong feature specific to TICE (educational long-distance platforms including multimedia modules) instruments and tools, and allows using a mixed pedagogical method: classic education as well as interactive education offering the possibility to regroup students in a flexible manner. Each student group created on a national level shall have its own tutor/trustee who shall supervise all students` evolution on professional and psycho-educational level

The applicative practice shall be performed either inside industrial units with a similar profile (industrial logistics) or inside partner universities, by transferring software programmes for the aplications etc..

3. EURO-QLIO PROPOSES A NEW SPECIALIZATION IN THE MECHANICAL ENGINEERING FIELD

Quality, as any other specialization, is addressed to a certain special industry field. All specialists of this field may be sort of detached of those performing production projection and systems. This is due to the special regime given by quality. Thus all quality specialists have an independent regime as subordinates (they need a certain

independence towards the management) inside a company and regarding production matters. At the same time, it is true that the production process requires technical methods and solutions to be applied in order to limit/diminish the number of wastes, by involving measurement and static control systems. This fact produces benefic effects in a company by cutting/reducing necessary costs. All managers of an organisation/company very well know all advantages created by implementing quality management, but they are difficult to be understood by a mechanical engineer. Therefore, in order to avoid being a constraining factor, a quality specialist needs to own a extra certain preparation in the economical field, apart from his education in the mechanical engineering field. These two competenecies shall allow the quality specialist to provide clear organizational and re-organizational production solutions, thus becoming a viable partner of the company`s management. In order to fulfill all these, the graduate of the new specialisation needs have an economical education.

The EURO-QLIO graduate has a complex education, on the border between engineering and economy, with the following competencies:

- he is familiar with the basic scientific knowledge and he is able to expand his horizon by studying, he is highly competent in one or more scientific fields;
- he can easily adapt to research activities – development, he assimilates new knowledge by researching, he knows the meaning of team work in order to achieve a goal using a methodical manner;
- he is highly competent in carrying out projection/designing activities in order to add a new value based on predefined requests and desires;
- he is familiar with systemic methodologies of scientific approach for problem engineering, characterized by using theories, methods as well as coherent interpretations in an adequated manner, he has a critical attitude and a large perspective on science and technology;
- he is highly competent in cooperating and communicating, and capable of working with other specialists, he has or may develop leadership qualities and has good communication skills in his relationship with his colleagues and his opponents;
- he owns basic intellectual qualities, being highly competent to motivate, reflect and elaborate valid analysis fully aware of the arguments provided, abilities learnt or/and perfected by discipline, applicable in a generic manner;
- he has a deep sense of temporal and social context, as science and technology do not develop independent of the social environment, being connected with it as well as with the temporat conditions, judgments and methods addopted and the decisions addopted in the technological and scientific field produce concequences over the time.

Analyzing a graduate`s competencies misses an indicative factor of their level of performance. Taking into account the particulat context of these aspects, we have accepted a four dimensions indicator to reflect each participat`s level which allow us to correctly appreciate and introduce each graduate in society, instead of using an overfulfilled indicator. These four dimensions are:

- the analytical dimension which appears when performing a phenomenon clasification activity, systems` or problems` clasification activity, in different phenomena classes or laws aiming to produce a certain intention;
- the synthetizing level establishes each graduate`s capacity to integrate more elements into a coherent scientific structure which serves the fulfillment of a certain goal, resulting a product, a theory, an interpretation or a model;
- the levels of abstraction represent the procedure through which a theory, a model or a sentence is taken to a higher level of generalisation, with the purpose of making it applicable to solving certain issues from certain fields;
- the objectifying level means applying a general point of view in a certain situation or particular case, it being bigger when such problem involves more aspects.

The EURO-QLIO project`s complex multinational feature, which involves three universities coming from different heterogeous environments, evaluation represents a complex activity, absolutely necessary for defining the graduate`s level and especially quality of assimilation during the educational process and determining the graduate`s competencies at the end of the educational process.

The evaluation system of the students` scientific and professional performances involves an ensemble of methods, forms, types and criteria of evaluation and appreciation. In order to obtain a double and respectivelly a triple acreditted diploma acknowledged by the organs of each state, this ensemble of methods has to satisfy the different requests of each state`s member of this project. Therefore all of these requests nedd to be strictly fulfilled. For example, in France, in order to obtain a licence, the applicative practice is performed at the end of the

educational process (after 5 semesters), for 8 weeks. In Romania, the University of Mechanical and Mecatronic Engineering the applicative practice is performed at the end of every two semestres for two weeks. According to the aforementioned principle, the EURO-QLIO students have to perform a two weeks applicative practice at the end of each two semestres in the first two years and an eight weeks applicative practice in the next year.

Furthermore, the students` professional-scientific performances are an essential feature of the curricular management being part of the coherent and interdependent succession of the main actions which form the educational process cycle, of projection – teaching – evaluation cycle. As a qualitative feature, the students` evaluation of scientific-professional performances is an integrated part of the pedagogycal evaluation system of the educational processes and structures as the students` evaluation results is an information source for evaluating and re-evaluating of the curricum, the professors` teaching manner, the relevance of the supporting materials, the efficiency of the educational process and last but not the least of the academical structures` functionality. The evaluation results of the students` professional-scientific performances have to be integrated in the collegial procedures of analyze, of surveillance and periodic evaluation of the educational programmes and professors as they represent a synthetic indicator of the learning results.

4. QUALITY EVALUATION OF THE EURO-QLIO PROJECT EDUCATION PROCESS

Herein, we shall make a reference to the evaluation methods describing the procedures, techniques and instruments for verifying the EURO-QLIO students` level and quality of knowledge/preparation and for receiving all the necessary information for determining the grades/qualificatives which certify and officialize this level. The evaluation/verification methods together with the teaching and learning ones are part of the teaching process. The evaluation methods may be different depending on the procedures, techniques used and on the examination forms they are integrated in. The evaluation methods may be as follows:

- Oral examination – free representation, evaluation conversation, oral examination of the student, the interview – they are all difficult to initiate in the virtual campus though lately the information technology and especially voice over IP type techniques have considerably reduced the consumption of resources.
- Written examination – the theme and verification data can be published on the page of the course, and the material accomplished by the student can be uploaded on the same page by conditioning the access to be configurated in such manner that only the proffessor shall have access to see and download them. The evaluation instruments and tools are as follows: essays, medium and long term projects, written studies, current written studies (in the seminaries), final evaluation written studies (in the examination session), evaluation questionnaries, report papers, portfolios etc..
- Applicative examination – consists of applicative studies and laboratory practice, projects, observing and analyzing practical activities carried out by students. This type of verification can not be implemented for the virtual campus, therefore we shall use classical teaching and verification method within the new method, with the advantaje of permitting a flexible working programme, teaching and performing the applicative studies.
- Tests or knowledge tests, hand-written or electronically (on line). This evaluation method has been one of the first methods initiated for long-distance learning platform. The advantage of using e-learning platforms is the usage of alternative evaluation possibility: true-false, equivalence, multiple selection, completion and short answers.

The evaluation types are defined in accordance with its objectives, within the discipline, with its functions/effects produced in the teaching-studying-evaluation process, with its frequence and at the time of performing them. There are three types of evaluations: initial evaluation, continuous evaluation (formative) and final evaluation (summative).

The initial evaluation can be performed at the beginning of a studying process with its scope to:

- Establish the knowledge level and the capacities previously obtained, in order to buid a solid base necessary for digesting new knowledge and capacities. The advantage offered by EURO-QLIO is the possibility of readapting the teaching methods for each separate individual, for a discipline and also for an entire workpackage. In case of tracking down lacks of knowledge or in case of requiring profound study, we can offer the student an entire alternative educational chain. Personnal development is not punctually evaluated but in a continuous manner thus obtaining a real evaluation.
- Collect necessary information for projecting a new stage in the educational process, including the intercalation of recovering sequences or putting knowledge up-to-date, in order to prevent the storage of gaps/deficiencies and to ensure a continuous learning process on a global level.

- Evaluate the most important initial points for making an educational progress, by comparing it with the initial indicators, the final ones, and the dynamics indicators for the educational process.

Continuous evaluation is performed during the learning period, being periodically tested in writing and orally, applicative studies and laboratory studies, report papers, projects and many more. Thus the teaches gets an operative feed-back, to improve the educational process and is concentrated on the next level of this process. The continuous evaluation allows informing students on the educational level they have reached and prevents failure at the final examinations.

The final evaluation, also called summative, is performed at the end of a compact studying period, respectivelly at the end of the studying period of the respective discipline (usually the semester), at the end of the universitary year (performed on the assemply of the studying disciplines), at the end of a studying programme. The final evaluation shall be performed with exams planned during the examination sessions, with the final exams at the completion of a studying programme, and with complex investigations and analyses regarding the final result of the studying process.

The evaluation criteria are intended to ensure a direct relation between the performance levels of the students and the evaluation level appointed by grades or qualificatives and by resolution of the qualificative system in order to obtain an objective element to compare the grades collected at different disciplines, for different students, at different evaluation forms and/or by different professors. These evaluation criteria are decided by a coordination group for the pedagogycal activites of the EURO-QLIO project, taking into consideration the specific features of each country.

In order to provide a high quality, the EURO-QLIO project intends to use ISO 10006:2003 international standard as an instrument which has a guiding role, for ensuring projects` quality management. It presents in general lines the principles and practices of quality management, whose implementation is important in achieving the objectives regarding projects quality, with a particulary impact on the the project undergoing.This standard has an additional guidence role in relation to ISO 9904:2004. Also, total quality management (Total Quality Management- TQM) develops, creates, extends and incorporates a quality culture, through which the objective of every single member of the organization is satisfying the requirements of the beneficiaries, which are sovereigns. It is known that the beneficiaries of the education process are:

-primary beneficiaries: students
-secondary beneficiaries: parents and employers
-tertiary beneficiaries: the labor market, public institutions and society
-internal beneficiaries: the didactic and administrative staff

The EURO QLIO project aims to offer all of these beneficiaries what they want, when they want, and how they want. This involves adopting to the changes in expectations of beneficiaries and the practice of creating products and services that reach and exceed expectations. In the case of primary beneficiaries, they desire an education process easy to go over, with a minimum effort, but which can form them at the highest level possible, that can allow them to integrate rapidly in the labor market. In the case of secundary beneficiaries, employers ocupie a special place.They are the ones who absorb the product of education, the ones that determine the necessary training, because they are the ones in need of graduates who have cartain skills and competences.They can also determine the maximum level or minimum level of training and are the ones that can directly influence the labour market. For this reason employers must be attracted into the project both to finance the preparation of graduates and to ensure themselves about the level of training,skills and competences desired. Another important factor is composed of the advisory role, because the learning process is a living one,dynamic, that can be influenced by students (quality and quantity), employers (competences and abilities), government (legislative framework and social framework),society (popularity and ethics).Otherwise it is recognized that perceptions and expectations are changeable, sometimes capricious and therefore organizations must find ways to maintain contact with beneficiaries,to be able to respond to their modifications of tastes, needs and desires.

An important role in the education process is the ''raw material''.Education can be regarded as a production line through the ''supply of the well prepared human resource''.However, it must be taken into consideration that for a product to be subject of the quality assurance process, the manufacturer has the obligation to identify, to comply with the requirements and to select suppliers.Thus the link between higher education and pre-universitary needs to be strengthened.Therefore, within the finaincing there are organized ''open days" at the Faculty of of Mechanical Engineering and Mechatronics to attract high school graduates into the project.This is not enough though.We believe it is important to have a permanent contact with high schools so we can be in touch with the preparation of high school students and organize activities for adjusting and correcting the pre-competences needed by the high technical education.

''Raw material" must go through, in the educational process a series of predetermined starndard processes with clear specifications, after an initial selection process has benn made.With EURO QLIO this aspect is not applicable to students.To obtain quality ''final products", courses must be organized that are intended to correct the existing deficiencies due to the lack of a selection process, and the education process must become more efficient.Often, it is impossible to produce stundents at a imposed standard, because the education process involves an interaction between the knowledge provider and the receivers.This can not be removed because there is no initial selection process,and in consequence the final products of the education process can be unsuccesful. Also, the components of the education process may be designed wrong,without respecting specifications.For example, obtaining a low report between the number of students and the number of teachers assumes low efficiency conditions, and therefore, cost control is also a concern of quality management.

We can look at the education process as a service.Poor quality of services is due to the work of the employees and due to their atitude, that is indifference, lack of training or interest.This aspect can be corrected by motivation, professional development and satisfying the work teams needs.By bringing economic agents into the project the demands of the secondary beneficiaries and offer will increase.But the most important aspect consists of creating a direct and permanent contact with the consumer, making a close relationship between supplier and consumer.Professional development is achieved through teamwork and mobility.Teams at EURO-QLIO,are joint teams composed of teachers that come from the tthree member countries: Romania, France and Bulgaria.The good practices exchange, knowledge transfer, imposing a particular way of teaching to ensure the quality level demanded, all of these lead to a good professional development of future specialists in the field.

Another important factor in the education process is time, because any process involving knowledge transfer, obtaining skills and habits is made in a pre-scheduled time interval, and this thing is as important as its specific characteristics.Moreover, all courses and educational activities are being consumed in the same time with providing them, during a long period of time, quality control or inspections coming always late.Increasing personnel, interaction with students and employers provide an answer, and an evaluation in a shorter period of time, thus making the main, but not the only way to appreciate the level of the beneficiaries satisfaction.

5.CONCLUSIONS

The Erasmus EURO-QLIO project supports the assurance of quality in the education process and responds to the internationalization demands of the labour market by implementing the transversal competences, due to the realization of transnational tematical connection, through the internalization of the educational process, by creatin a virtual campus and by creating a partnership that includes the demand-industrial partners, and offer-universities.

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