Communication

Acquired Competences in the Medical Higher Education - A Statistical Approach

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Abstract: The results of an investigation among the graduates of the "Carol Davila" Medical University, regarding perception of competences necessary to a physician and how much of these competences is acquired during the studies are presented.

Keywords: Competence; Somer index.

Introduction

One of the present activities of the universities' world is the evaluation of the place occupied for the different universities/faculties in their hierarchy determined by the quality of the transmitted knowledge. In this context a very actual preoccupation is the description of the profile of faculties by using the competences acquired by the graduates.

In this paper the results of some investigations inside the "Carol Davila" University of Medicine and Pharmacy in Bucharest are presented, investigations that took place during the projects CEEX05-D8-66 and P4 91-047 financed by the Romanian Ministry of Education and Research to evaluate the perception of students/graduates about the quality of the learning process. The main objective of the aforementioned projects is to establish techniques of comparative evaluation for university qualifications in Romania, and the objective of this paper is to propose a basis for the evaluation, in the medical higher education, of competences specific to the medical domain.

Material and Method

General Data

The medical higher education in Romania has a tradition of over a century and is characterized by a pregnant curricular stability. Of course, the main declared objective is to educate well-prepared individuals for the national health system.

By tradition, in the Romanian medical higher education system three major specializations are encountered, which need a long term education (6 or 5 years, i.e. 360 or 300 transferable credits), namely those of physician, dentist, resp. chemist. The curricula that correspond to these "major" specializations are totally different. As the other specializations, which impose only a short-term education (3 or 4 years, i.e. 180 or 240 transferable credits), their palette is larger and variable enough in time. According to the present situation, in the list of these specializations we find nurses, assistant in physio-kineto-therapy and recovery, assistant in radiology and imagistic, assistant for clinic labs, dental assistant or specialized in dental technique, pharmacy assistant. By opposition to the long term education, in these 3 or 4 years of short-term study the students follow substantial common curricula.

It is of highest importance to identify the major tendencies that are manifest in the Romanian medical higher education, due to the fact that on the sanitary "labor market" a new promotion of about 5-6 thousand graduates is launched each year.

The absolute data regarding the number of graduates of all universities in Romania are represented in Figure 1. All types of higher education, except the medical one and the legal one, witnessed an increasing tendency during the last years. The economic higher education continues to manifest a tendency to increase the market share. On the contrary, for the medico-pharmaceutical higher education, the 1990-2006 general evolution, and also the last four years' tendency of the market share, is clearly decreasing. The limit value is about 5%, this means that in future we expect only one of 20 graduates to possess a physician or related diploma.
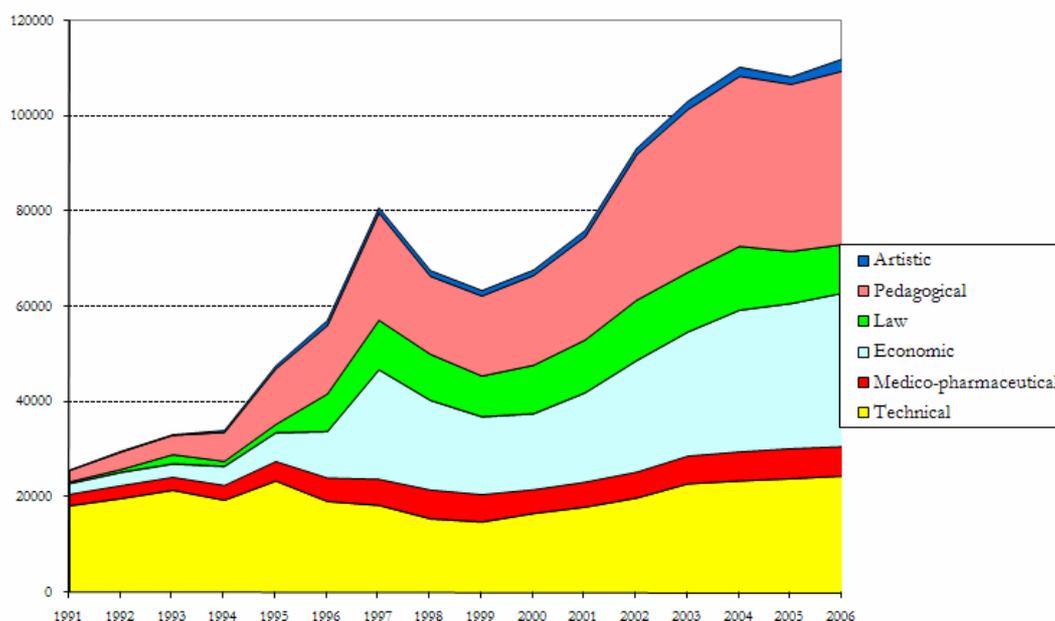
Figure 1. Evolution of the number of graduates on types of higher education (1991-2006)

Competences and their classification

One of the present activities of the universities' world is the evaluation of the place occupied for the different universities/faculties in their hierarchy determined by the quality of the transmitted knowledge. In this context a very actual preoccupation is the description of the profile of faculties by using the competences acquired by the graduates. In 1999 the "Bologna Declaration" was adopted, intending to make (as much as) compatible the higher education qualifications in the different European countries, declaration adopted by 28 countries, including Romania.

Actually in all Romanian universities large efforts are made to describe the framework of qualifications that are offered by the respective universities, possibly inside the **European Qualification Framework**. After a three cycle higher education system has been adopted (bachelor, master, doctoral studies), other important objectives of the educational policy have to be approached, namely:

- Creating a national framework to define, **on domains of study**, the qualifications **in terms of competences**. In this framework, the higher education curricula should correspond to competences defined for specializations, with accent on the final results of the educational process.

- Orienting the educational process – which actually is more oriented toward the educators – such as to have as target **the student with his vocational qualities**. This objective of reorienting the higher education should be realized in the learning process itself, but also in the examination procedures.

- Realizing an academic education that:

1. Is less specialized and **more flexible** in the study curricula, during the first learning cycle (bachelor).
2. Responds to **market demands**, allowing quick integration of graduates.

In this general framework, the medical academic education has its own particularities. Its principal characteristic is the fact that **is long-term** education, whose stages cannot be "burned out". When compared to othe types of university qualifications, it is easy to detect much wider area knowledge necessary to a physician in the modern society. Moreover, in the last few decades we witness a continuous enlargement of new knowledge that has to be assimilated by physicians, knowledge that is more and more linked to modern technologies, such as the information and communications technology. The new integration perspectives of European nations into a unique entity impose to physicians the mastering of several languages at a high level.

Let us specify, in what follows, some important terms that will be intensively used in the present paper.

The term **competence** reflects the capacity, the ability, or the skill that a person possesses when performing an activity, a task ([1]). "Competent" is a *positive* attribute associated to the respective person.

Sometimes this attribute of "yes/no" type can be graded, and we speak about the "degree of competence" of a person, and this allows creating a hierarchy of persons according to this degree.

The academic competences are those competences that are associated to higher education graduates, i.e. are acquired and developed during the university and post-university education process ([2], [3]).

In what follows the term competence will denote in fact an academic competence. It is obvious that to a person, which graduates from a faculty, we should associate not one, but a set of competences. In this context appears a first classification of competences, into:

- **Generic competences (GEN)** that refer to general learning abilities, to analysis and synthesis abilities, but also to practical skills.

- **Vocational competences (VOC)** that obviously refer to abilities acquired during the educational process and are strictly connected to the vocation and profession of the graduate.

In general, competences are grouped into so-called **competence areas**. We distinguish three such competence areas:

a) Area of competences linked to knowledge acquired during the educational process (DEP). The competences from this category are specific to the major activity domain of the graduate (i.e. artistic, economic, legal, medical-pharmaceutical, pedagogical, technical). They suppose, among others:
1. Possessing knowledge at expert level in one or several disciplines from the studies curriculum.
2. Being capable to do scientific research.
3. Being capable of designing new systems or technologies.

b) Area of competences linked to the use of academic methods (UAM). Competences from this area are not necessarily associated to a major domain; on the contrary, they are common to several domains and, in general, are common to intellectual approach of problems. They suppose:
1. Knowing how to scientifically approach a problem (this means knowing theories, models, and technologies).
2. Possessing intellectual skills (that means emitting judgments, logical reasoning etc.).
3. Being competent in cooperation and in communication (that means working in a team, leading other people and assuming responsibilities, publicly debating problems etc.).

c) Area of competences that are related to understanding of the temporal/social context (CTX). The competences from this category refer in general to knowing and expressing the specialized knowledge in several languages, to knowing the social and national/local specific aspects, in general to knowing the multicultural aspects of human societies. This area of competences covers also the *third mission* component of a graduate, component that should not be neglected in any educational process.

The competences previously described are acquired in general by following the three standard cycles of higher education, that is bachelor, master, doctoral (which in the medico-pharmaceutical domain are reduced to only two cycles: bachelor (?) and doctoral). When designing a university curriculum for a specialization, depending on the profile of the faculty, it is necessary to take into account the developing of all kind of competences, but obviously with **different weights**. To be able to realize this in a rational manner we have to identify the specific competences and to find a way to **measure** them. In general, when following this approach, for each competence a nominal scale is adopted, and for it a number of modalities are specified. Statistical techniques are successfully used in preliminary stages ([4], [5], [6]), more precisely in the identification and the measure of competences. The populations under statistical scrutiny have to be the following three: (a) the graduates of the faculty, (b) the professors, which are component in the formation of these competences (they are also those whose expertise is exploited in designing analytical programs) and (c) the employers that directly benefit from the product of the educational process, which is the graduate as specialist in the domain. These three populations should be investigated by sampling, by using special designed questionnaires in representative samples.

To ease the statistical approach, a third classification of competences is used, in which we distinguish between three main categories:

A) Instrumental competences (INS), which refer to:

- Cognitive abilities supposing the capacity to understand and manipulate ideas and concepts;
- Methodological capabilities to organize the available time, to learn, to take decisions, to solve practical problems;
- Technical/technological and informing abilities;
- Linguistic abilities (writing and communication in at least two languages).

B) Interpersonal competences (INT), which suppose:

- Capacity to express opinions, to develop critical (and self-critical) analysis;
- Abilities to work in a team (including inter-disciplinary teams).

C) Systemic competences (SYS), which refer to:

- Knowledge of techniques of system analysis (for example to understand the own specialization as a component of a larger system);
- Capacity of managing projects;
- Capacity to adapt to new situations.

The statistical analysis of answers given to questions in questionnaires leads to a good description of competences needed, and that should be acquired, in the specializations under study.

Results

Preliminaries

A preliminary investigation has been conducted, in 2006-2007, in the frame of the research project EFISIN (CEEX05-D8-66/11.10.2005). This investigation lead to a clear conclusion: for the students of the "Carol Davila" University approaching graduation, the term "competence" is rather wrongly interpreted, the vast majority of students associating minor meanings to it (of type "to perform an intramuscular injection").

More precisely, in one of questionnaire investigation, to the request:

„Mention five competences that you successfully acquired during the university studies"

some 480 answers were obtained from the students of year V or VI that were selected in the sample (with a non-response rate of only 30.4%).

Among these answers, only one can be catalogued as "negative" (it was "reduction of sleeping time"). As sporadic answers, a few personal competences were indicated, which could be grouped into: (1) general human competences (such as capacity of concentration, developing attention, developing the reasoning, punctuality, responsibility) and (2) competences linked to the future profession (use of specialized medical language, selecting information, a.o.)

Rather frequently "general technical" competences were indicated, some from extra-medical domains (use of the English language, use of computers and browsing the Internet, presenting materials in public), the most part from medicine (first-aid help, correct anamnesis of patients, correlating data, choosing a diagnosis a.o.). It is worth noting that neither teamwork abilities, nor competitive problem solving abilities were ever mentioned. Also, we have to underline the fact that too many "technical" competences that are specific to assistants/paramedics and not to physicians were mentioned (measuring blood pressure, dressing wounds, doing intramuscular injections a.o.)

Evidently, some of the students mentioned instrumental professional competences (knowledge of surgeon instruments, interpreting EKG and CT, elaborating primary diagnosis), but the proportion of inadequate mentions – concerning the acquired competences – was well over 50%, and this cannot be fully explained by the fact that the university studies were not completed at the time of filling in the questionnaire. A more plausible explanation is that the lack of specifying the competences in the curriculum (i.e. disciplines that are studied) is negatively influencing the understanding by students of their role and importance.

Organizing the study

By help of specialists in medical psychology the first questionnaire used in the project COMPESIN (P4 91-047) was adapted to students in medicine. The questionnaire was intended to investigate the degree of acquiring different potential competences, and was used simultaneously in nine universities from Romania.

In the "Carol Davila" University a number of 155 students from the final (VIth) year of study, promotion 2003-2008, were investigated; these represent over a quarter of the graduates of the Faculty of Medicine. The students were asked to give an evaluation of the importance of acquiring the respective competence (for the future activity in the profession), and also an evaluation of the level attained given the faculty offer.

The questionnaire contained some other questions, aiming at identifying the "quality" of the graduate and of his/hers intentions regarding the future doctoral studies.

The questionnaires were not anonymous, during the completion the graduates were assisted by IInd year students involved in the investigation process. The first priority was to avoid superficial answering, due to lack of diversity in the questions regarding competences.

The list of competences under investigation, together with the respective place in the previous three classifications, is as follows:

1.	Capacity for analysis and synthesis	GEN, UAM/DEP, INS
2.	Capacity for organization and planning activities in profession	VOC, UAM, INS
3.	Capacity for gaining basic knowledge of profession	VOC, DEP, INS
4.	Use of a second natural language in profession	VOC, UAM, INS
5.	Use of computer and other IT&C devices	GEN, UAM, INS
6.	Use of alternative information sources (library, Internet)	GEN, UAM/DEP, INS
7.	Capacity of independent decision-making	GEN, UAM, INS
8.	Teamwork (in profession)	GEN, UAM, INT
9.	Ability to work in inter-disciplinary team	GEN, UAM, INT
10.	Capacity for applying acquired knowledge in practice	GEN, DEP/CTX, SYS
11.	Ability to learn and to do research independently	GEN, UAM, SYS
12.	Capacity to adapt to new situations	GEN, CTX, SYS
13.	Ability to work independently	GEN, DEP, SYS
14.	Capacity for being rigorous, concern for quality	GEN, UAM, SYS
15.	Capacity for project design and management	GEN, UAM, SYS

The questions regarding competences were marked 3 – 17 in the questionnaire. As a rule, such a question has two parts:

a) In the first part the respondent is asked for his/hers opinion about the importance that he/she is attaching to the acquisition of the respective competence for the profession:

Extremely important	Important	So and so	Mediocre	Not at all important	Cannot evaluate
1	2	3	4	5	6

b) In the second part the opinion regarding the level attained (due only to the facilities offered by the faculty) is asked:

Very high	High enough	Medium	Low	Very low	Cannot evaluate
1	2	3	4	5	6

Ideally, for those competences that are characteristic to a modern expert-specialist, the respondent should select the options "Extremely important" and respectively "Very high", and this implies serious concordance between the two opinions. (Note that we do not know precisely which competences and in what proportion are necessary to the specialist in the medical domain!)

To be in position to compare the opinions regarding the importance of different competences, the values of an **importance index** are computed; this index is obtained by weighting the modalities of variable (a) by the following weights:

Extremely important	Important	So and so	Mediocre	Not at all imp.
1	0.75	0.5	0.25	0

To compare opinions regarding attained levels of acquired competences, the values of a **level index** are computed; here the modalities of variable (b) are weighted by:

Very high	High enough	Medium	Low	Very low
1	0.75	0.5	0.25	0

These two indices have values between 0 and 1, and values close to 1 are mainly of interest for our study.

To evaluate the concordance between variable (a) and variable (b), adequate concordance indices have been calculated. These variables are ordinal; hence the Somer index ([7], [8]) has been preferred, it's computing being implemented into SPSS. This index has values between -1 and 1. Due to the non-linearity of the Somer index, values over 0.6 indicate substantial concordance, and negative values indicate discordance.

The significance level, computed by help of the χ^2 distribution, can be also used to indicate possible statistical dependencies between the two variables, (a) and (b). However, this index is specific to continuous variables; hence the Somer index was preferred to evaluate the concordance.

In this phase of the project only the population of students approaching graduation was investigated. Their opinions, essentially subjective, have been processed statistically using SPSS v.15, which computes both the Somer index and the significance level. The results of the processing, inclusive by help of (Microsoft) Excel 2007, will be presented in what follows.

Statistical study

A thorough clustering of all answers given to questions 3-17, by using the distance based on the Pearson correlation coefficient on on the discordance proportion between variables (which is the best adapted to our situation), reveals a lack of association between variables, except those associated to questions 14 (Capacity to adapt to new situations) and 15 (Ability to work independently). Therefore the conclusion that the answers were independent is fully supported.

The Table 1 below presents the results reported by the statistical software.

The computed values of the importance index are contained in a relatively narrow interval, between 0.75 and 0.90. These values reveal that our future graduates consider all the above competences as having a relatively high importance for the profession.

The most unfavorable value is for the "Capacity for project design and management". Probably the medical students appreciate that physicians do not need too much from this competence, in their profession.

The most favorable values are for "Capacity for being rigorous, concern for quality", and then for "Capacity for applying acquired knowledge in practice". It is beneficial that students have opinions of this kind.

The computed values of the level index are contained between 0.30 and 0.50. These are much lower than the previous ones and reveal a low contribution of the faculty in the formation of these types of competences.

The most unfavorable value is for the competences "Use of a second natural language in profession" and "Capacity for project design and management". Probably the students compensate by other means the deficit of contribution of the faculty in creating linguistic competences! But it is clearly marked that during the studies there is no concern to prepare them for designing and managing projects!

A last remark: with a single exception, no value on the last two columns reveals the existence of concordance in opinions, or of some "significant" statistical dependence. We may assert that the answers were not manipulated.

The only exception is the very high significance level (0.888) for the "Ability to work in inter-disciplinary team". However, this value is not sustained by a notable value of Somer's concordance index! The previous conclusion is general!

Table 1. Statistical indicators associated to data obtained from the questionnaire

Competence	No. resp.	Impor-tance	Level	Somer index	Significance
Capacity for analysis and synthesis	153	0.85	0.48	-0.098	0.660
Capacity for organization and planning activities in profession	154	0.77	0.37	-0.050	0.060
Capacity for gaining basic knowledge of profession	150	0.84	0.49	0.170	0.054
Use of a second natural language in profession	153	0.80	**0.30**	-0.030	0.690
Use of computer and other IT&C devices	154	0.81	0.34	0.110	0.501
Use of alternative information sources (library, Internet)	155	0.83	0.43	0.110	0.029
Capacity of independent decision-making	154	0.86	0.34	-0.090	0.090
Teamwork (in profession)	150	0.83	0.40	0.039	0.225
Ability to work in inter-disciplinary team	149	0.82	0.34	-0.090	**0.888**
Capacity for applying acquired knowledge in practice	152	**0.88**	0.37	-0.056	0.467
Ability to learn and to do research independently	152	0.85	**0.50**	0.009	0.401
Capacity to adapt to new situations	153	0.86	0.39	0.005	0.309
Ability to work independently	155	0.85	0.41	-0.086	0.524
Capacity for being rigorous, concern for quality	153	**0.90**	0.44	0.036	0.207
Capacity for project design and management	151	**0.75**	**0.30**	0.128	0.083

As a general conclusion about questions 3–17 regarding the acquired competences, we may assert that the answers given by the future graduates in the sample were specific, genuine and not at all superficial, even if the questionnaire has been monotone.

Discussion

Figures 2 and 3 present the distributions of answers given by the future graduates to the set of questions 3-17 in the questionnaire. (Remind the total number of answers varies from 149 to 155.) Note the extent of all answers "Extremely important" in Figure 2 and, by contrast, the extent of answers "Very high" in Figure 3.

We can easily notice that the majority of future graduates consider all the investigated competences as being important for the profession. Especially the "capacity for applying acquired knowledge in practice" and the "capacity for being rigorous, concern for quality" are appreciated as extremely important. The lowest places in the ordering after the importance index are occupied by

the "capacity for project design and management" and by the "capacity for organization and planning activities in profession".
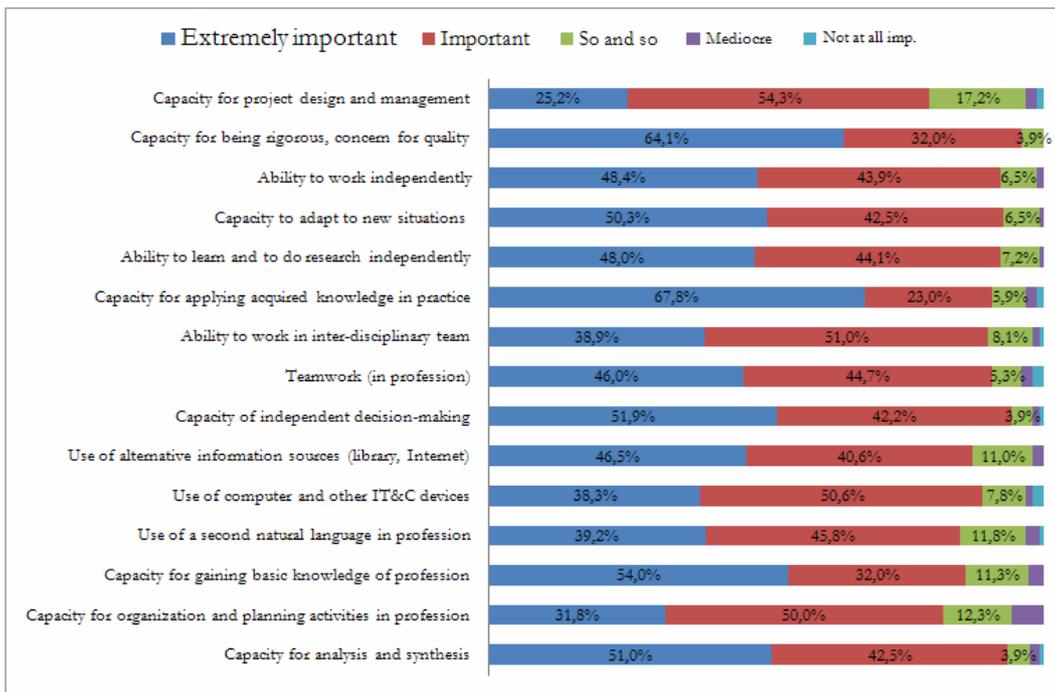

Figure 2. Investigated competences - evaluation of their importance for a physician

Figure 3. Investigated competences – evaluation of the level attained after the studies

One of the initial objectives of the investigation is to evaluate the contribution of the faculty in forming each competence in turn at the level attained by the graduate.

It is clear from Figure 3 that the majority of our 2008 graduates consider that the faculty assures a "very high" or "high" level of forming only for the following competences:

- Capacity for project design and management, 62.3% (but this is judged as "not important" competence!)
- Use of a second natural language in profession (61.5%)
- Use of computer and other IT&C devices (57.8%)
- Capacity of independent decision-making (55.2%), and
- Ability to work in inter-disciplinary team (50.3%).

The competences that are not well developed by the faculty are, in the opinion of our respondents, the following:

- Ability to learn and to do research independently (29.6% "negative" evaluations),
- Capacity for gaining basic knowledge of profession (24.0% "negative" evaluations), and
- Use of alternative information sources (library, Internet), 22.0% "negative" evaluations.

Perhaps the bi-dimensional representation of the two indices, in Figure 4, is more relevant.

The forming of instrumental competencies are – relatively – better served by the faculty than the forming of systemic competences, which are judged as more important (with one notable exception, that of the „capacity for project design and management"). Deficiencies in forming the "capacity of independent decision-making" and of the "capacity for applying acquired knowledge in practice" are stressed out.
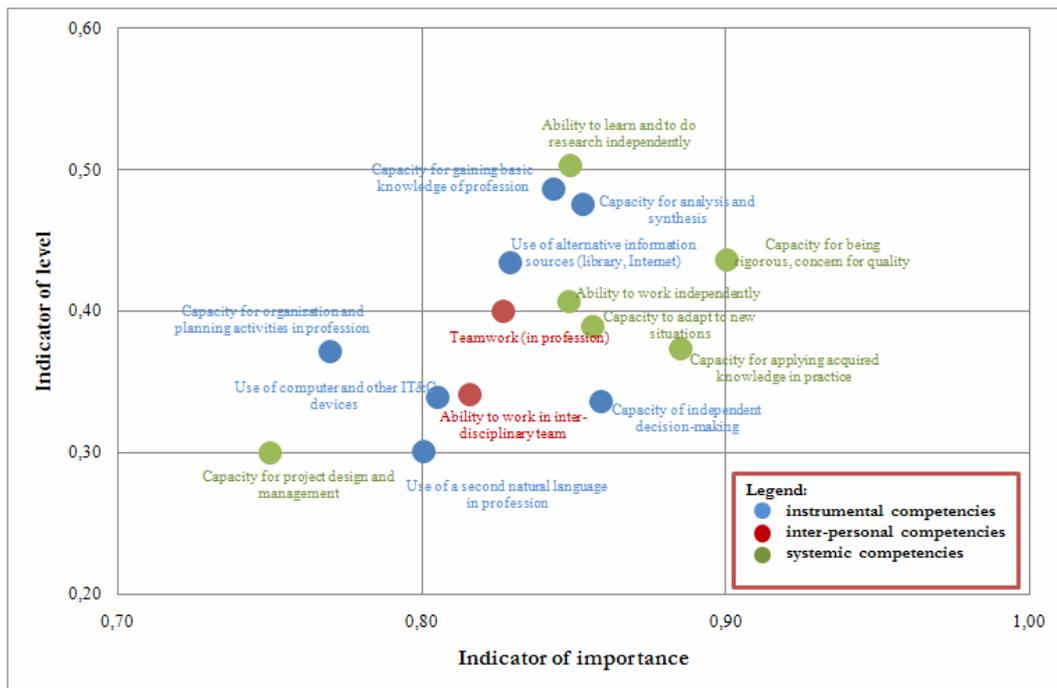

Figure 4. Competences - importance vs. level attained, in the opinion of respondents

Ideally, for the competences that are judged by the graduates as being "very important" for the profession, the faculty should assure a "very high" level of forming them. This ideal is rarely attained in a faculty. To identify the deviations from this standard ideal, we may order the investigated competences by the difference between the importance index and the level index. This ordering is presented in Table 2.

Notice that all the differences are positive, and this is revealing low quality evaluation!

According to this ordering, the main deficiencies in the activity of forming competencies in the faculty appear in the "capacity of independent decision-making", "capacity for applying acquired knowledge in practice" and "use of a second natural language in profession".

Table 2. Ordering of competences by the difference importance index minus level index

Competency	Difference importance - level
Capacity of independent decision-making	0.52
Capacity for applying acquired knowledge in practice	0.51
Use of a second natural language in profession	0.50
Ability to work in inter-disciplinary team	0.47
Capacity to adapt to new situations	0.47
Use of computer and other IT&C devices	0.47
Capacity for being rigorous, concern for quality	0.46
Capacity for project design and management	0.45
Ability to work independently	0.44
Teamwork (in profession)	0.43
Capacity for organization and planning activities in profession	0.40
Use of alternative information sources (library, Internet)	0.40
Capacity for analysis and synthesis	0.38
Capacity for gaining basic knowledge of profession	0.36
Ability to learn and to do research independently	0.35

Other Results

Some other questions were inserted in the questionnaire, asking for the intention to continue or not the higher education, following the doctoral studies. Of course, the majority of the respondents (62%+24%) are aware of the dynamic of the profession and of the respective specialization. Probably this is a good reason why the vast majority (137 respondents, representing 89.5% from the total) responds "Yes" to question 22 (Do you wish to continue your university studies?)

The detailed opinions regarding the willingness to continue the specialization by following doctoral studies are presented diagrammatically in Figure 5. Very few respondents (only 3%) appreciate that the specialization will end once their studies are over. The majority (64%+19% = 83%) is willing to continue the specialization in the medical field (in the same domain or in a similar one). The indecision rate is very low, of only 8%. Also, only 6% are willing to specialize in domains other than the medical one.
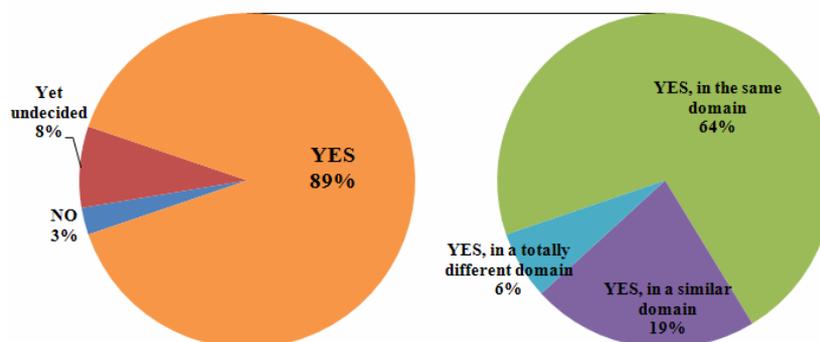
Figure 5. Opinions regarding the continuation of university studies

On the basis of these data we estimate that around 80% of the university graduates will try to continue the university studies in a way or another, in majority by following doctoral studies.

Conclusions

The main conclusions derived from processing the data obtained from questionnaires are as follows:

1. The high response rate, of over 97% to all questions, reveals the willingness of the future graduates to contribute to the success of the investigation. The answers were specific, genuine, and not superficial, even if the questionnaire was rather monotone.
2. Over 80% of the graduates are willing to continue their university studies, in a way or another, in majority by following doctoral studies.
3. The respondents consider as important for the profession, with importance indices of over 0.75 on the linear scale [0 – 1], all the competences proposed in the questionnaire. Comparatively, the most important are considered the capacity for being rigorous, concern for quality and the capacity for applying acquired knowledge in practice (values near to 0.9).
4. On the linear scale [0 – 1], the respondents evaluate at a much lower level the contribution of the faculty in forming these competences. Especially deficiencies in forming the capacity of independent decision-making and of the capacity for applying acquired knowledge in practice are stressed out.

It is desirable to involve the experts in medicine, from the inside and from the outside of the university, in an effort to specify the general competences of the profession, also the competences that are specific to each discipline of study. To make explicit these competences, inside an official document addressed to the students as early as possible, even before the admission contest, will greatly contribute to raising their perception about the profession.

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