Relevance Evaluation of a Master's Degree in Engineering in Peru

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Abstract. A good engineering education has a direct impact on competitiveness and the development of a country. In the context of the increase and diversification of higher education, it is necessary to ensure not only the quality, but also the relevance of master's programs in engineering; that is, to say the appropriateness of objectives and results to the needs and interests (national and regional) of program beneficiaries. After a literature review and interviews with experts, one should propose a model for evaluating the relevance of a Master's program in Engineering in Peru, considering certain factors, indicators and verifiers.

1. Introduction

Most universities are organized according to the structures of scientific disciplines (mode 1). The research was carried out according to this form of organization and curricula are also organized around that which these disciplines produce. However, a new mode of knowledge production with own characteristics that affect the carrying out of the research and the education in universities has surged, named by Gibbons Mode 2 [1].

According to Gibbons, mode 2 has a "distributed system of knowledge production" where universities no longer have the monopoly of knowledge production. In mode 1, problems arise and are solved in the context governed by interests (mainly academic) of a specific community, while in Mode 2, knowledge is produced in a context of application, when one attempts to solve a real problem in a complex system, in a territory, in a determined social, economic, political and environmental context.

Most universities do not question the ingrained belief that mode 1 is the only way to produce fundamental knowledge. However, mode 1 does not provide knowledge in an application context, which is precisely what is needed by developing countries. These countries need to solve local problems in the short term, understanding that complex systems cannot wait until the disciplinary structures come to address their specific needs.

The relevance is not as linked with the generation of new knowledge – making discoveries– and depends on the capacity of higher education institutions to engage others in the production of knowledge by means of the innovation process. A master's degree in engineering is relevant if the objectives proposed are appropriate to the training needs of students and the interests of the university, and if they solve problems of socio-economic context, thus contributing to their community development.

2. Evaluation model for the relevance of a master's program in engineering.

The model used to evaluate the relevance of master's degree in engineering in Peru, consists of 5 actors and 28 indicators, as shown in the following chart:

Chart 1. Evaluating Factors of the relevance of a master's program in engineering

Factor	Indicators
1. Personal satisfaction of graduates and employers	6
2.Linking of professors and research with the environment	7
3. Concordance of contents	7
4. Linking to the socio – economic environment	6
5. Concordance of the global master's program management with the interests of the University	2
	28

2.1 Factors:

2.1.1. Personal satisfaction of graduates and employers

A master's degree in engineering is relevant if it satisfies the training needs of students. These students are professionals who work in a context in which specialized knowledge is necessary for solving problems. A graduate of the program will be satisfied if the master's helped him or her to: improve his or her job performance, develop skills, improve his or her employment status, whether it is in contact with him or her after completion of the program. Employers, in turn, will be satisfied if the best achievements of the work performance of these students results in an overall benefit for the company [2], [3].

2.1.2 Linking of professors and research with the environment

According to Hansen [4]; Etzkowitz [5] and Gibbons [1], interactions between universities, industry, and the state are the basis for accessing economic development. A master's program is most relevant if it promotes multidisciplinary scientific research focused on problems, and if the Master's Thesis projects are geared towards the solution of problems for business or the development of an innovation project.

2.1.3 Concordance of contents

As suggested by Yamada [6] and Mouzakitis [7], there must be an adaptation of content (curriculum) with the needs and interests of students and with the needs of the labor market. A master's program is also relevant to the development of trans-disciplinary subjects, innovation, and project-based learning [1].

2.1.4 Linking to the socio – economic environment

A master's program is most relevant in the manner in which it is linked with the socio-economic environment, with the labor market and local and national government guidelines for economic development [8].

2.1.5 Concordance of the global master's program management with the interests of the University

A master's program in engineering is relevant if its objectives are relevant to the interests of the university. There must be a correspondence between the direction and management of the master's with the policies and the working procedures of the host university, because it is the university which finally decides if the master's degree will be granted or not.

2.2 Indicators and verification sources.

Factor	N°	Indicators	Verification source
1. Personal satisfaction of graduates and employers	1.1	Studying the master's degree helped to increase the employment chances of graduates (to receive a raise, a promotion or getting a better job).	Survey for graduates
	1.2	Knowledge acquired in the master's helped to get better job performance of graduates.	Survey for students, graduates and employers
	1.3	Knowledge acquired in the master's satisfies the needs in the current workplace.	Survey for graduates
	1.4	Competencies established by ABET (2011) were developed for the engineering degrees (11 competencies).	Survey for graduates Interview for directors of the master's program
	1.5	Useful strategic competencies for everyday life were developed.	Survey for graduates
	1.6	A system for monitoring the performance of graduates functions.	Survey for graduates and employers Interview for directors of the master's program and directors of the university, separately.
2. Linking of professors and research with the environment	2.1	Professors participate in networks or scientific and professional associations.	Document review (certifications, intellectual production and agreements) Interviews for directors of the master's program and directors of the university, separately.
	2.2	Professors have academic mobility.	Interviews for directors of the master's program and directors of the university, separately.
	2.3	The organization of the university facilitates multidisciplinary research focused on problems.	Document review (Regulation of Organization and Functions of the University), projects and contracts. Interviews for directors of the master's program and directors of the university, separately.
	2.4	There are a number of research projects with external funding (national or international) in recent times	Document review Interviews for directors of the master's program and directors of the university, separately.
	2.5	The final projects of the master's program have applications in business.	Surveys for graduates and employers Interview for directors of the master's program
	2.6	The final projects of the master's program solve problems in business.	
	2.7	The final projects of the master's program develop in an innovation project.	

Factor	N°	Indicators	Verification source
3. Concordance of contents	3.1	Topics given in the master's program are related to work topics or according to the interests of the student.	Survey for students and graduates
	3.2	The curriculum of the master's program helps to satisfy real or regional needs.	
	3.3	There is an agreement among the mission, objectives and strategies of the master's degree with the program content.	Documental review for norms, regulations, documents and curriculum. Survey for students and graduates Interview for directors of the master's program
	3.4	Syllabus are updated according to the requirements of the students and graduates	Survey for students and graduates Interview for directors of the master's program
	3.5	Subjects promote trans-disciplinary studies and innovation	Documental review for curriculum and contents of the master's program.
	3.6	An approach of project-based learning is used	
	3.7	The university offers undergraduates or specialization programs related to the master's degree	Survey for students and graduates Interview for directors of the master's program
4. Linking to the socio – economic environment	4.1	Master's program content is related to local, regional or national development guidelines; and to the trends on existing professional practice	Documental review (regional and national development plans, sectorial and competitiveness plans)
	4.2	The master's program and its educational goals satisfy a demand for education in the region	Documental review (market research of the master's program) Interview for directors of the master's program
	4.3	The master's program covers a professional and labor environment's need	Survey for students, graduates and employers
	4.4	The master's program helps to resolve problems affecting the most vulnerable sectors of society	Survey for employers Interviews for directors of the master's program and directors of the university, separately.
	4.5	There are effective relationships with similar programs at other universities, business, government agencies, and NGOs, among others.	Documental review (pacts, agreements) Interview for directors of the master's program
	4.6	The master's program has an advisory committee composed of representatives of key stakeholders	Documental review (Resolution of the creation of the Committee and minutes) Survey for employers Interviews for directors of the master's program and directors of the university, separately.

Factor	N°	Indicators	Verification source
Concordance of the master's program management with the interests of the University	5.1	The mission and objectives of the master's program are coherent to the mission, goals and strategies of the University that teaches it	Interviews for directors of the university.
	5.2	Is the management of the master's program developed according to the policies and working procedures of the University?	

3. Conclusions

A master's degree in engineering in Peru is relevant if it meets two conditions: first, if it satisfies the needs of their students, that is, to say, if it acquires specialized knowledge and develops skills to solve complex problems in a given territory. Second, if it helps the University to have a major role in the distributed system of knowledge production, developing applied research, solving local problems in partnership with businesses and public entities sharing resources and exchanging technology. The proposed model for evaluating the relevance of a professional master's degree in engineering emphasizes these two aspects.

Therefore, this model will be applied in evaluating the relevance of master's programs in engineering in the University of Piura, Peru.

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