JOURNAL OF EDUCATIONAL SCIENCES THEORY AND PRACTICE Vol. 16, No 2, 2021

Received: 28, 10.2021
DOI:10.46763/JESPT2116209t
UDC: 378.014.6:331.5
378.091.214.18:331.5
Revised: 02.12, 2021.
Accepted: 03.12.2021

DETERMINATION OF THE STUDY PROGRAM COURSES CONTRIBUTION TO THE PROVIDED QUALIFICATIONS IN RELATION WITH THE LABOR MARKET NEEDS USING AHP

Riste, Timovski[1], Tatjana, A. Pacemska[2]

Faculty of Computer Science, Goce Delcev University, Stip, Macedonia
riste.timovski@ugd.edu.mk, tatjana.pacemska@ugd.edu.mk

Abstract. The implementation of the Quality Assurance System (QAS) in Higher Education in each University varies, depending on multiple different factors and overall, the vision, mission, and the culture of the institution, covering aspects such as study programs, courses and their substantial aspect, teaching and learning methodologies and techniques, functional and non-functional relations between the University and the students, research and science, student affairs, etc. One of the key aspects is the content of the study program courses (their substantial part) and the relations with the labor market needs. Even though it is not mandatory to use mathematical modeling and/or information technology as a supporting tool, it is inevitable when the research needs to network large amount of data in an automated way, so the final result will be comprehensive enough in taking into consideration all the important parameters. The mathematical modeling technique AHP is applied towards the determination of the study program courses that are most efficient in fulfilment of the labor market needs on the one hand, and the provided qualifications with the study program on the other hand.

Key words: QAS – Quality Assurance System, HE – Higher Education, AHP – Analytic Hierarchy Process, LO – Learning Outcomes, EQF – European Qualifications Framework

Introduction

The European Standards and Guidelines (ESG) call for the QA systems in Europe to pay attention to the learning outcomes of the study programs. Also, the qualifications' framework according to the Bologna process determines that study programs must specify their content having learning outcomes in their focus. European Qualification Framework (EQF) is developed by EU as a translation tool for making national qualifications easier to understand and compare. Qualifications Framework pushes the cross-border mobility of learners and workers, thus promoting lifelong learning and professional development and migration across Europe. The EQF aims to relate different countries' national qualifications systems to a common European reference framework. NQF is the instrument for establishing a system of qualifications acquired in a specific state, giving the basis for acquisition of qualifications, their mobility and quality.

One of the key pillars of NQF (as well as in Macedonian Qualifications Framework) is *Real and clear modelling of the qualifications expressing the needs of the labor market, the relevant skills and social-economic stability*. Following national and international development, qualifications provided with the study programs must implement the following goals to be more competitive (several goals from the MQF are shown, regarding the relation with the labor market):

- Clear definition of the learning outcomes;
- Enable patency (horizontal and vertical) through formal, nonformal and informal education and training programs;
- Enable international comparability of the qualifications;
- Enable mobility in the education and training process, as well as inclusion in the labor market, in domestic and foreign space;
- Enable compliance with the economic, social and cultural needs of the state;
- Enable mobility of the work force (with appropriate qualifications' recognition) at national, regional, and international level;
- Make qualifications easily readable, and
- Create a unique quality assurance system.

All of the above-mentioned goals of the NQF systems in Europe unequivocally lead to the creation of a quality assurance system that will continuously follow the relationship between the learning outcomes provided with the active study programs in the HE institutions and the labor market needs. This system should be applied periodically, thus it will enable us to determine the courses or parts of the study programs that need to be optimized regarding the labor market needs - change of the study program content related to the modern trends in the field and the real need of the market. This would allow us to overcome the still burning fact of the existence of content in study programs (or courses, even all courses) which is repetitive and/or unnecessary.

Study programs are accredited with proposals for accreditation of a study program, approved by the Agency for Quality in Higher Education (Republic of North Macedonia), consisting of: the Board for Accreditation of Higher Education, the Board for Evaluation of Higher Education, and the Director of the Agency. Within the proposals, learning outcomes are defined with two categories of qualifications descriptors:

- General qualifications, referring to the general skills and knowledge the graduated student is provided to acquire with the courses and the study program completion and will be able to use them in the professional development, and
- Specific qualifications, referring to the concrete skills and competences provided within the study program, related to the specific content of the courses.

Two aspects are analyzed in this research, networking them towards generating a single final report about the study program courses quality:

- What is the level of achievement (contribution level in achieving the outcomes / qualification descriptors or qualifications) of the provided qualifications within the proposals of the accredited study program, seen in terms of each course separately, and
- What is the need for those qualifications, seen in terms of the labor market?

Networking of those two datasets is done using the Analytic Hierarchy Process (AHP). It is a mathematical tool – optimization technique that integrates the answers to both questions and produces a unique, objective and consistent final report for the courses' quality.

Materials and methods

The research is done on the study program Computer engineering and technologies, the Faculty of Computer Sciences, Goce Delcev University in Stip. Two questionnaires were built towards gathering the information for the two aspects for analysis:

- Questionnaire 1 – evaluation of the importance of the qualifications provided with the study program (what is the real need for those qualifications in terms of the labor market), and
- Questionnaire 2 – evaluation of the level of fulfilment of the qualifications provided with the study program in terms of each course separately (are those qualifications really provided within the courses).

Two general and two specific learning outcomes were the subject of analysis, shown in Table 1.

Table 1 Generic and specific qualifications

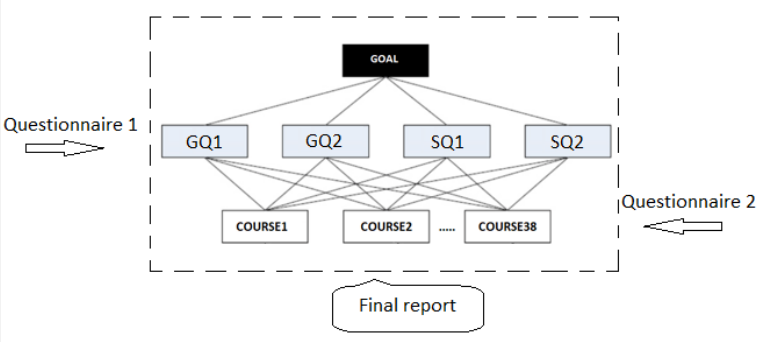
Type of LO	Qualification	Qualification description
General (GQ1)	Knowledge and understanding	Express knowledge and understanding for ICT, programming languages concepts and algorithms, data bases, computer architecture, and operating systems
General (GQ2)	Ability for evaluation	Demonstrate the ability for gathering, analysing, interpretation and use of data, information and problems. Ability for the level of feasibility of software project
Specific (SQ1)	Application of knowledge and understanding	Demonstrate skills for design, implementation and verification of computer systems and components with different complexity. Apply efficient principles for projecting of computer systems and networks
Specific (SQ2)	Learning skills	Can easily adapt in mastering of new computer technologies or programing environment. Demonstrate awareness for new technologies and ability for evaluation and use of modern computer systems.

Questionnaire 1 was conducted directly with the important representatives from the labor market, domestic and international. 19 companies' representatives (CEOs, CFOs, senior engineers, project managers, owners) were questioned to evaluate the importance of four chosen qualifications, one in relation to another. The evaluation was done in evaluating the importance of each criteria in relation to every other, using a 7 layer-of-importance scale when comparing the criteria in pairs (1 - first criterion is only important, 2 - first criterion is more important than the second, 3 - first criterion is slightly more important than the second, 4 - equal importance of the criteria, 5 - second is slightly more important than the first one, 6 - second is more important than the first one, 7 - second is only important). This was translated into the 9-scale-of-importance related to the AHP technique.

Questionnaire 2 was conducted directly with the students from the above-mentioned study program. Total of 47 students from the generation 2017 and 76 students from the generation 2018 were interviewed, giving their perception in relation to 38 courses that were chosen from the study program to be evaluated, related to the contribution level of the courses towards the four provided qualifications (two general and two specific) using the Likert's scale (evaluation of the contribution level with 1 – No contribution, 2 – Little contribution, 3 – Some contribution, 4 – Big contribution and 5 – Complete contribution).

AHP is an optimization technique used for organizing and analyzing complex decisions, using math and psychology. Developed by Thomas L. Saaty in the 1970, it consists of three main parts: the ultimate goal / problem to be solved, all the possible alternatives or solutions that decision has to be made between, and all the criteria the judgements regarding the alternatives will be made upon. AHP enables the transition qualification → quantification, which is very clearly shown in this research, thus allowing mathematical manipulation with the data gathered, towards the final report generation. The model built within this research enables the inclusion of the two most important stakeholders in the HE processes: labor market (questionnaire 1) and students (questionnaire 2). The model is shown in Figure 1. The ultimate goal is to find the best (list) course in terms of relative efficiency, regarding the level of contribution in provided qualifications as they are structured in the study program. The criteria are the four qualifications, evaluated from the labor market, thus having the information what is more and what is less important related to their perception. Their answers are pair-wised in the AHP mechanism, producing a unique scale of the criteria's weights. The alternatives are all 38 courses evaluated in this research. Students evaluated each of them related to each of the four criteria.

Figure 1. Model for evaluation of the courses quality regarding the qualifications provided and their need's assessment from the labor market



Results and discussion

Regarding the labor market questionnaires and the data processing through the AHP mechanism, Table 2 is generated, showing the weights = importance of the four qualifications from the point of view of the labor market.

Table 2 Importance of the provided qualifications

Qualifications	Importance scale
GQ1: Knowledge and understanding	0,12913
GQ2: Ability for evaluation	0,10492
SQ1: Application of knowledge and understanding	0,28972
SQ2: Learning skills	0,47622

As it can be seen from Table 2, the most important qualification (outcome) for the ICT companies, regarding the students from this study program is the Specific Qualification: Learning skills. Thus, companies are assured that regardless whether graduated students will be more or less aware about the specific environment of the company, technologies, HW and SW used in their work, they will be able to easily accommodate and learn all the specific techs for fast involvement, progress, and personal and professional development as an employee. General Quality 2: Ability for evaluation is assessed and AHP calculated as least important. This means that evaluation is less important regarding all other qualifications. It can be assumed that this qualification is something that a new employee can learn in later years of engagement. In order to be sure in the objectivity and the soundness of the importance scale, the inconsistency factor is calculated within the AHP mathematics: CI = 0,01314. This means that the inconsistency in the judgements from the companies is 1,3%. Given the fact that AHP allows only judgements with inconsistency less than 10%, the importance list is very convenient.

After processing the data from Table 2 with the results of questionnaire 1, the data shown in Table 3 is calculated.

Table 3 Final quality report in terms of relative efficiency

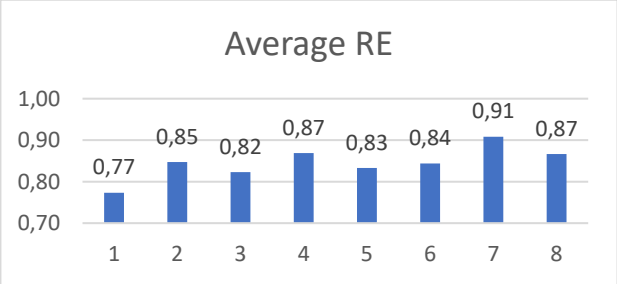
Course	Semester	Relative efficiency
ICS	1	0,71
CE	1	0,51
M1	1	0,86
PB	1	0,95
DM	1	0,87

LA	1	0,74
DL	2	0,73
M2	2	0,86
OOP	2	0,98
AS	2	0,86
INF	2	0,88
CA	3	0,78
SE	3	0,73
DSA	3	0,93
PS	3	0,86
GT	3	0,79
DB	4	0,99
VP	4	0,92
CN	4	0,90
OS	4	0,79
GV	5	0,87
IP	5	0,88
IT	5	0,79
AA	5	0,79
SS	5	0,80
DSP	6	0,86
MCS	6	0,82
BOR	6	0,76
MAD	6	0,99
AI	7	1
E-Com	7	0,98
DMS	7	0,83
GeoI	7	0,84
SCS	7	0,93
ASERE	7	0,87
DCS	8	0,81
IS	8	0,71
ML	8	0,97

Given the information in Table 3, several conclusions can be made:

- Relatively most efficient course (RE = 1) is AI which is the course Artificial Intelligence. This course fulfills the most wanted criteria by the labor market in a relatively ideal combination.
- Relatively least efficient course (RE = 51) is CE which is the course Computer Elements. This course fulfils the criteria in a relatively worst possible way.
- Conducting the analysis on a semester level, it can be noted that going into the higher semesters, the contribution levels, and the overall efficiency (quality) index is higher. This can be due to the fact that higher semesters contain courses that are more professional (clinical) towards the final qualification the graduated students are awarded.

Figure 2. Semesters' RE average



Conclusion

The proposed model for evaluation of the level of contribution of the study program courses related to the provided qualifications has a direct connection with the need of the labor market regarding those qualifications. AHP enable this networking in a unique way, thus enabling us to generate the final report of courses that contributes more or less to the provided qualifications, given in terms of the importance scale of those qualifications. Four qualifications were examined out of ten available from the accreditation proposal of the study program Computer engineering and technologies, Generation 2017. The model is fully scalable, enabling change of the criteria = qualifications in need to be examined, depending on the perception and the specific study program to be analyzed. The importance scale can be used for the overall optimization of the study program and its courses towards producing qualifications that are more challenging and demanding on the labor market. Also, the final report can be appropriately used to determine the courses that will need change in the content/essence, towards their better performance.

References

Aziz, N.F. and Sorooshian, S. and Mahmud, F. (2016). ***MCDM – AHP METHOD IN DECISION MAKINGS***. ARPN Journal of Engineering and Applied Sciences, Vol. 11, NO. 11, June 2016. ISSN 1819-6608

Alonso, J.A. and Lamata, T. (2006). ***Consistency in the analytic hierarchy process: A new approach***. International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems. Vol.14, No.4 (2006) 445-459

Gass, S. (2001). ***The Analytic Hierarchy Process-An Exposition***. Operations Research. 49. 469-486. 10.1287/opre.49.4.469.11231.

European Centre for the Development of Vocational Training CEDEFOP (2021). *European Qualifications Framework (EQF).* https://www.cedefop.europa.eu/en/projects/european-qualifications-framework-eqf

European Union (2021). *The European Qualifications Framework.* https://europa.eu/europass/en/european-qualifications-framework-eqf

Saaty, R.W. (1987). ***The analytic hierarchy process – what it is and how it is used***. Math Modelling, Vol. 9, No. 3-5, pp 161-176. 0270-0255/87

Stankeviciene, Jelena and Vaiciukeviciute, Agne (2016). ***Value creation for stakeholders in higher education management***. DOI: 10.15240/tul/001/2016-1-002

The European Association for Quality Assurance in Higher Education ENQA. (2015). *Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG)*. https://www.enqa.eu/wp-content/uploads/2015/11/ESG_2015.pdf

Youssef, Lamrani Alaoui. (2019). ***Introduction to MCDM Techniques : AHP as Example***. 10.13140/RG.2.2.15536.30724.

Национална рамка на квалификации (2021). *Цели на НРК.* http://registar.mrk.mk/

Агенција за квалитет во високото образование АКВО (2021). *Акти и регулативи на АКВО.* http://www.akvo.mk/index.php