



UNIVERSITY OF NOVI SAD TECHNICAL FACULTY "MIHAJLO PUPIN" ZRENJANIN



ITROCONFERENCE¹³
INFORMATION TECHNOLOGY AND EDUCATION DEVELOPMENT



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INTRODUCTION

This Proceedings comprises papers from the International conference on Information technology and development of education that is held on line on November 25th 2022. The International conference on Information technology and development of education has had a goal to contribute to the development of education in Serbia and in the region, as well as, to gather experts in natural and technical sciences' teaching fields. The expected scientific-skilled analysis of the accomplishment in the field of the contemporary information and communication technologies, as well as analysis of state, needs and tendencies in education all around the world and in our country have been realized. The authors and the participants of the Conference have dealt with the following thematic areas: - Theoretical and methodological questions of contemporary pedagogy - Personalization and learning styles - Social networks and their influence on education - Children security and safety on the Internet - Curriculum of contemporary teaching - Methodical questions of natural and technical sciences subject teaching - Lifelong learning and teachers' professional training - E-learning - Education management - Development and influence of IT on teaching - Information communication infrastructure in teaching process All submitted papers have been reviewed.

The papers presented on the Conference and published in this Proceedings can be useful for teacher while learning and teaching in the fields of IT, informatics, technics and other teaching subjects and activities. At the end of the conference, and based on the papers of our participants, we conclude that the main focus points of this moment in education. Contribution to science and teaching development in this region and wider has been achieved in this way.

The ITRO Organizing Committee would like to thank the authors of papers, reviewers and participants in the Conference who have contributed to its tradition and successful realization.

Chairman of the Organizing Committee
Ph.D Dragana Glušac

IN MEMORIAM PROFESSOR DIJANA KARUOVIĆ 1978-2022.

We especially want to pay tribute to our late colleague professor Dijana Karuović PhD, as one of the founders of the ITRO conference.

To all of us who knew her, professor Dijana Karuović will be a symbol of professional attitude towards work, dedication and loyalty to the institution to which she belonged. Behind HER remain her wonderful children, her many scientific works, her goodness and her love.

We are grateful to have known her.

Also, we will always remember our dear colleague professor Ivan Tasić, PhD, who passed away in 2019.

Our team thus suffered an irreparable loss, and their names will forever remain on the pages of the conference proceedings.



Professor Dijana Karuović and professor Ivan Tasić

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Assessment Report and Functional Qualitative Analysis of the Current Condition Regarding the Qualification Standard: Teacher in Higher Education in Republic of North Macedonia

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Abstract - The role of a higher education teacher is just one of the dimensions and attributes of the academic profession. Anyone with the necessary qualifications, engaged in the academic world is expected to possess a pool of professional academic roles through the whole career, such as teacher, researcher, manager, contributor etc. We have worked on a development of a Standard of qualification: Teacher in higher education within the international Erasmus + project, where one of the activities was evaluation of the current condition with the proposed key qualifications for the teachers in higher education and their expectations in the future, using mathematical modeling techniques. This resulted in a determination of the current qualitative levels regarding different categories of teachers, in terms of the specific qualifications of the teacher, called key job tasks, provided within the Standard.

qualities of the teacher in higher education and develops competencies that make the same teacher more competitive on the labor market. It is expected that the labor market in our country will establish conditions and criteria for advancement that each of the teachers will identify with.

Continuation of education. The teacher qualification standard in higher education is inextricably connected and conditioned by the informal learning and professional development of teachers. Each of them needs to continue their education in order to maintain and develop the quality of their knowledge, skills and attitudes.

The needs of the individual and/or society. The qualification teacher in higher education is related to the need of the individual to acquire personal competencies to improve his knowledge, skills and attitudes for successful and high-quality realization of work tasks arising from the profession itself. Achieving the standards of qualifications leads to self-actualization, satisfaction of the teacher's internal motives, but also recognition and validation of the desires, affinities and achievements of teachers by the institutions in the system.

I. INTRODUCTION

The teacher qualification standard in higher education is directly related to the:

Needs of the labor market. The qualification: Teacher in higher education primarily refers to the acquisition of knowledge, skills and attitudes for the realization of teaching activities in higher education institutions. The qualifications standard includes the competencies that teachers in higher education have acquired during their formal education (undergraduate level, master's level and doctoral level), includes the experiences gained during their classes/teaching in higher education and also the competencies that the teacher in higher education should acquire and upgrade during lifelong learning process and through various forms of professional development. All of the above mentioned strongly improves the

II. KEY JOB TASKS OF THE STANDARD AND METHODS USED FOR EVALUATION

Based on the implementation document of the Qualification Standard: Teachers in higher education in Republic of North Macedonia, 10 different key job tasks regarding the qualification and related competencies were evaluated in order

to determine parameters describing the current condition about their fulfillment between the teachers, each containing specific number of different areas of competences and learning outcomes in each of them:

- Has knowledge in the scientific field;
- Realizes scientific and professional research and their application in the teaching process;
- Realizes and supports teaching, learning and studying;
- Values students;
- Mentors students;
- Applies new technologies in teaching, learning and studying;
- Communicates and cooperates with all participants in the teaching process;
- Permanently and life-long improves professionally and collaboratively;
- Acts entrepreneurial, and
- Practices and creates media and critical literacy.

A. Surveys

Towards collecting the necessary data to be processed through the proposed model for evaluation of the current and expected condition related to the 10 key job tasks of the qualification teacher in higher education, complex survey was conducted among the teachers in higher education in Republic of North Macedonia during the period 15.2.2022 – 5.3.2022, targeting different universities, titles, types of financing of the institution and scientific field of the title acquired:

- Surveys answers: 160
- Universities targeted: 8
- Different titles targeted: 8 (Full professor, Associate professor, Assistant professor, Senior lecturer, Lecturer, Senior lector, Professor of a Higher Vocational School, Assistant doctoral student)
- Different scientific fields targeted: 6 (Natural and mathematical sciences, Technical-technological sciences, Medical Sciences and Health, Biotechnical Sciences, Social Sciences and Humanities).

For evaluating the current qualitative level of possession of each learning outcome (key job task) which are questions in group Q1, their

current practicing, realization and application, following levels were used:

TABLE I. ASSESSMENT LEVELS OF THE CURRENT CONDITION OF POSSESSION OF THE KEY JOB TASKS RELATED TO THE QUALIFICATION STANDARD

Evaluation level: Type 1	Evaluation level: Type 2	Number
Almost never	Completely disagree	1
Rarely	Closer to NO	2
Often	Closer to YES	3
Almost always	Completely agree	4
Do not have an opinion		0

For evaluating the level of need for improvement regarding the key job tasks which are questions in group Q2, following levels were used:

TABLE II. ASSESSMENT LEVELS OF THE NEED FOR IMPROVEMENT OF THE KEY JOB TASKS CURRENT CONDITION

Evaluation level	Number
Not necessary	1
Have an insignificant need	2
Have an exceptional need and necessity	3
Have a significant need	4

For evaluating the level of readiness of the teacher to contribute as an educator, which are questions in group Q3, following levels were used:

TABLE III. ASSESSMENT LEVELS OF THE READINESS FOR CONTRIBUTION IN THE IMPROVEMENT PROCESS

Evaluation level	Number
Would not make any contribution	1
Would make a small contribution	2
Would make a significant contribution	3
Would make an outstanding contribution	4

B. Mathematical modeling techniques and evaluation model

Two optimization techniques were used to build the evaluation model:

- AHP – Analytic Hierarchy Process, and
- DEA – Data Envelopment Analysis.

AHP enables creation of listing (depend on the criteria) showing (in this application of AHP) the most present key job task among the HE teachers (with best evaluation levels), with the importance of the criteria included and bias excluded.

DEA enables generation of final QA report, pointing to the relatively efficient and inefficient titles in HE depending on the level of presence of the key job task, related to the resources invested in gaining those key job tasks.

The proposed model is shown on the figure.

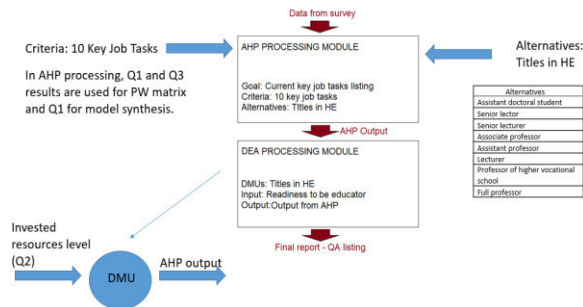


Figure 1. Evaluation AHP+DEA model

The criteria that are used in AHP are represented with the 10 key job tasks. Units that are used as alternatives in AHP, and in the same time are Decision Making Units (DMUs) in DEA are the 8 different titles that are targeted with the model. The processing of the data via AHP is done using Super Decisions software. The processing of the data via DEA is done using OSDEA software.

III. RESULTS AND DISCUSSION

The result from the surveys Q1, Q2 and Q3 is shown as an average indexes assessed by the targeted teachers from all categories mentioned above, shown in the following table.

TABLE IV. ASSESSMENT LEVELS OF THE READINESS FOR CONTRIBUTION IN THE IMPROVEMENT PROCESS

Criterion	Key job task	Average level / Current condition (Q1)	Need for improvement (Q2)	Readiness to be educator (Q3)
1	Has knowledge in the scientific field	3,22609	2,5652	3,4222
2	Realizes scientific and professional research and their application in the teaching process	3,20838	2,6666	2,8863
3	Realizes and supports teaching, learning and studying	3,5996	2,2666	3,4418
4	Values students	3,7413	2,3333	3,2727
5	Mentors students	3,8063	2,1555	3,409
6	Applies new technologies in teaching, learning and studying	3,6776	2,6666	3,1363

7	Communicates and cooperates with all participants in the teaching process	3,7938	2,5277	3,2045
8	Permanently and life-long improves professionally and collaboratively	3,6746	2,3778	3,25
9	Acts entrepreneurial	3,3923	2,4666	2,7045
10	Practices and creates media and critical literacy	3,6083	2,5555	2,8604

Based on the results in table IV:

- Related to Q1, highest score belongs to the key job task **Mentors students**, and the lowest score belongs to the key job task **Realizes scientific and professional research and their application in the teaching process**. This means that most effort by the teachers is invested into mentoring students, working individually and in small groups, which can be evaluated as pretty good. On the other hand, teachers are aware about their weak involvement into research activities and their implementation into the teaching materials.
- Related to Q2, highest score in the context of determination what is the weakest spot that needs most improvement, **Applies new technologies in teaching, learning and studying** is detected as an issue that needs most resources involved in the future (use of computers, tablets, smartboards etc.). **Mentors students** has the lowest score, which completely matches with the results from Q1.
- Related to Q3, key job task **Realizes and supports teaching, learning and studying** has the highest score. This means that regarding the readiness to help and be included in the conduction of the teaching process, teachers evaluated themselves with a highest grade. On the other hand, lowest score refers to the key job task **Act entrepreneurial**. This means that the teachers needs education and training on how to improve their entrepreneurial skills (teamwork, leadership, communication, customer service, financial skills, analytical and problem-solving skills etc.) in order to be able to transfer them to the students via the teaching process.

When processed via AHP model, priorities of the 10 criteria are generated. Results are shown on the next figure.

Inconsistency: 0.06030		
1Criteria1		0.04499
2Criteria2		0.03809
3Criteria3		0.06961
4Criteria4		0.13807
5Criteria5		0.19387
6Criteria6		0.11501
7Criteria7		0.16467
8Criteria8		0.09810
9Criteria9		0.05559
10Criteria~		0.08201

Figure 2. Priorities of the key job tasks

Based on the results, highest priority goes to Criteria 5, which is key job task **Mentors students**. According to the teachers, this is most important key job task a teacher should possess. On the other hand, lowest priority refers to Criteria 2, which is key job task **Realizes scientific and professional research and their application in the teaching process**. This means that these results about the importance of the key job tasks based on the teachers' perception are close to the level of the resources that teachers invested during their professional life into improvement their teaching capabilities (Best/Highest in mentoring their students and Worst/Lowest in expansion of their research activities towards implementation of new content and/or practical activities in their teaching). The index of incostistency is:

$$R.I. = 0.06030 \quad (1)$$

which means that the level of inconsistency of the judgements of the teachers is 6.03% and is bellow the highest possible rate of inconsistency that is 10%, so the results are acceptable and can be used for further processing. Bearing this in mind, with the complete processing of the data through the AHP model, the following results are generated:

TABLE V. AHP RESULTS

Name	Ideals	Normals
Senior Lecturer	1	0.136864
Associate Professor	0.951581	0.130237
Full Professor	0.930628	0.127369
Assistant Professor	0.92737	0.126923
Professor of HVS	0.924684	0.126556
Assistant Doctoral Student	0.904968	0.123857
Senior Lector	0.846694	0.115882
Lecturer	0.820608	0.112312

Based on the results, highest score in this environment of importance of the 10 key job tasks processed via AHP is achieved from the teachers with title Senior lecturer. Lowest score is achieved from the teachers with title Lecturer.

The processing of the data via DEA, based on the answers about resources invested in achieving the key job tasks / inverted index of the need to be educated towards achieving these key job tasks is shown in the following table (output index is the output of the AHP model):

TABLE VI. DEA MODEL

Evaluation Level	Input Resources Index	Name (DMU)	Output
3,6	1,4	3SeniorLecturer	1
NoData	NoData	6Lecturer	0.820608
NoData	NoData	2SeniorLector	0.846694
1,8	3,2	1AssistantDoctoralStudent	0.904968
1,9	3,1	7ProfessorofHVS	0.924684
2,78	2,22	5AssistantProfessor	0.927370
2,6285	2,3715	8FullProfessor	0.930628
2,1214	2,8786	4AssociateProfessor	0.951581
DEA Model (1 input, 1 output)			

With processing the data with output oriented VRS DEA model, the results obtained are shown bellow:

TABLE VII. FINAL DEA (EVALUATION) RESULTS WITH THE MOST AND LEAST EFFICIENT TITLES OF TEACHERS

DMU Name	Objective Value	Efficient
3SeniorLecturer	1	Yes
4AssociateProfessor	0,951581	
8FullProfessor	0,930628	
5AssistantProfessor	0,92737	
7ProfessorOfHVS	0,924684	
1AssisstantDoctoralStudent	0,904968	

This QA analysis positions the title Senior Lecturer as relatively most efficient category in this moment, regarding the current investment of resources in obtaining the Key Job Tasks (10 criteria) and their current possession and importance. On the other side, title Assistant Doctoral Student needs biggest changes towards improvement of these skills. Nevertheless the results point out relatively close final scores, improvements are possible. With further DEA mathematics, precise percents of the improvement

that needs to be done related to specific key job tasks can be calculated.

IV. CONCLUSION

The proposed model is designed in accordance to the Qualification standard: Teacher in higher education in Republic of North Macedonia. With networking the key job tasks that define this standard and their assessment from the teachers, reports can be generated giving precise information about their importance and present fulfillment related to different titles and/or scientific fields. We can agree that this kind of a model would require massive surveys to be conducted towards obtaining better picture of the current condition with the teachers' skills and capabilities. The model can be used as a mechanism for qualitative evaluation periodically or promptly, depending on the needs. These results can be compared to other countries and for sure used to create strategies and make further planning of additional training and education of certain titles / groups of teachers in higher education towards improvement of their weak skills and competencies through a life-long learning process, because of the dynamic world we live in.

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