

QUALITY OF EDUCATIONAL SERVICES – INDUSTRY 4.0 REQUIREMENTS

KVALITETA OBRAZOVNIH USLUGA -
ZAHTJEVI 4.0 INDUSTRIJE

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ABSTRACT

Industry 4.0 poses new demands on the labour market but also on universities the problem of adjusting educational courses for professions for which the required competences for future employees have not yet been defined. The Kano model was used in the research, the study was conducted among students, graduates and potential employers. The results obtained indicate a gap between the expectations of employers and students.

Key words: quality, higher education, servqual, Kano, industry 4.0

1. INTRODUCTION

Turbulent economic environment, ongoing industrial revolution 4.0 sets new requirements for universities in the scope of not only program content

but also the transfer of knowledge in a situation where 65% of students want to do a job/profession that does not yet exist. For the university it is a very big challenge.

The management of higher education institutions noticed the need for marketing management of the organization and paying attention to meeting the expectations of the commonly understood customer. In the literature on the subject, you can meet different categories of university clients. The classification of M. Alvarez and S. Rodríguez¹ is well known, who see the need to focus the attention of university managers not only on the needs of internal clients, such as university staff or student, but also on external clients, which should be understood as a generally understood society (employers, graduates).² The university responds to the market's demand in the future. In Poland, the "reindustrialization" project is being implemented as a pillar for responsible development (adopted by the Council of Ministers on February 14, 2017). The developed strategy is to present a new development model - a sovereign strategic vision, principles, goals and priorities for the development of the country in the economic, social and spatial dimension until 2020. and in the perspective up to 2030. In 2017, Polish Industry Platform 4.0 was established, which is to develop:³

- the assumption of a new approach,
- new business models,
- assumptions for the integrated use of the latest technologies.

At the time of writing the article there is no approved document with references for Industry 4.0 in Poland, only general assumptions for further development and potential demand for new specialties were published. Comparing the situation with China where the priority program Made in China 2025⁴ is implemented, aimed at the extensive implementation of Industry 4.0 in the country and the preparation of appropriate staff resources. The competitive-

¹ Marta Alvarez and Sebastián Rodríguez, "La calidad total en la universidad: podemos hablar de clientes?", *Boletín de Estudios Económicos*, 1997, Vol. LII, No. 161, s. 333–352.

² Tomasz Nitkiewicz and Zuhail Ayen, "Identifying key criteria in development of Industrial Engineering education", *MATEC Web of Conferences*, 183, 04008, 2018. <http://doi.org/10.1051/mateconf/201818304008> and Stasiak-Betlejewska, Renata, Michael Kaye, Marilyn Dyason and Katarina Stachova, "Students' expectations in the technical university services quality assessment, Efficiency and Responsibility In Education" 11th International Conference on Efficiency and Responsibility in Education, 2014, pp 767-774.

³ Anna Wiśniewska-Szałek, Sustainable Development in Accordance With the Concept of Industry 4.0 on the Example of the Furniture Industry Robert Ulewicz & Branislav Hadzima, eds. *MATEC Web of Conferences*, 183, p.04005, 2018. Available at: <http://dx.doi.org/10.1051/mateconf/201818304005>; Beata Ślusarczyk, (2018). Industry 4.0 - Are We Ready? *Polish Journal of Management Studies*, 17(1), 232-248. <http://doi.org/10.17512/pjms>, 2018.17.1.19

⁴ Beata Ślusarczyk, (2018). Industry 4.0 - Are We Ready? *Polish Journal of Management Studies*, 17(1), 232-248. <http://doi.org/10.17512/pjms>, 2018.17.1.19

ness of other production systems in other countries may be jeopardized unless they sufficiently prepare adequate human resources for new technologies. Such a situation is a big challenge not only for the economy but also for the education of such countries as Poland or Thailand. The European Union is launching special programs to adapt curricula to the requirements of industry 4.0. An example of such a project is the MSIE4.0-CBHE project.⁵ It has the aim of preparing a suitable education program that will meet the Industry 4.0 requirements. How to achieve a high level of satisfaction of education system stakeholders - students, graduates as well as employers? Not only the knowledge transfer system itself - the methodology of education is important, but also the proper assessment of the future needs of the turbulent labour market and the adjustment of program content to the future sometimes not yet defined needs.

2. DETERMINANTS OF THE QUALITY OF EDUCATION

When managing an educational unit at every level of education, one should ask how to achieve success, and thus provide a high quality education service tailored to market requirements. Such a complex process as education is conditioned by a large number of factors. They can be divided not only into internal (university) and external (surrounding) but also into:⁶

- positive - affecting the improvement of quality,
- and negative - affecting its reduction.

These factors are conditioned by many variables, including social and economic phenomena as well as individual and political expectations. These factors condition each-other, hence it seems reasonable to analyse them not only in terms of the impact on the quality of education, but also mutual interaction. The internal factors determining the quality of education include all the parameters that are inside the unit that implements the learning process, which include quality, openness of students, the nature of implemented program content. External factors determining the quality of education include everything that constitutes the environment of the unit implementing the learning process.

⁵ Curriculum Development of Masters' Degree Program in Industrial Engineering for Thailand Sustainable Smart Industry, <https://msie4.ait.ac.th/>

⁶ Robert Ulewicz, "System Approach to Assure Quality of Education at the Faculty of Management of Czestochowa University of Technology", *Polish Journal of Management Studies*, Vol. 8, 2013, 259-268; A. Hariharasudan and Sebastian Kot, "A scoping review on Digital English and Education 4.0 for Industry 4.0. *Social Sciences*, 7(11), 2018, pp. 0-13. <http://doi.org/10.3390/soecsci7110227> and Cheng, Y.C., Tam, W.M., *Multi-models of quality In education*, "Quality Assurance In Education", Vol. 5, No. 1, MCB University Press 1997.

In this group of factors, such features as location of the unit carrying out the process (e.g. extent of industrialization of the region).⁷

The quality of the didactic service will also be affected by the correct definition of not current but future market requirements. In order to determine whether the program frameworks meet the expectations of stakeholders, the Kano model can be used.

3. KANO MODEL

The Kano method is widely used to measure quality in different areas and against different types of products, both material and non-material. The rich literature of the subject indicates that it finds its application, for example in the classification of requirements in education, in logistics, information technology or in the definition of relations between people and the environment.⁸ In the literature we have examples of effective association of the Kano method with other quality management methods, e.g. QFD (Quality Function Deployment)⁹, Servqual or FMEA (Failure Mode and Effect Analysis)¹⁰, confirming its broad spectrum of impact.

At the core of the Kano method is the assumption that the features of a specific product, including services, have a multidimensional character and influence the level of customer satisfaction to a different degree. Some features of the service mainly have an effect on creating satisfaction, while others contribute to causing dissatisfaction.

⁷ Markus R. Lima, Rui M. Mesquita, Diana Amorim, Marlene Jonker and Gerald Flores, Maria Assunção, "An Analysis of Knowledge Areas in Industrial Engineering and Management Curriculum," *International Journal of Industrial Engineering and Management (IJIEM)*, 3(2), pp. 75-82.

⁸ Mahboube Arefi, Mahmood Heidari, Gholamreza Shams Morkani and Khalil Zandi, "Application of Kano Model in Higher Education Quality Improvement: Study Master's Degree Program of Educational Psychology in State Universities of Tehran", "World Applied Sciences Journal" 2012, no. 17 (3); Chen Chun-Chih, Chuang Ming-Chuen, "Integrating the Kano model into a robust design approach to enhance customer satisfaction with product design", *International Journal of Production Economics*, Vol. 114, Issue 2, 2008.; Lars Nilsson-Witell and Anders Fundin, "Dynamics of service attributes: a test of Kano's theory of attractive quality," *International Journal of Service Industry Management*, Vol. 16, No. 2, 2005, s. 152-168. and Mamunur M. Rashid, Junichi Tamaki, Sharif A.M.M., Ullah and Akihiko Kubo, "A Kano Model Based Linguistic Application for Customer Needs Analysis", *International Journal of Engineering Business Management*, Vol. 3, No. 2, 2011, s. 29-36.

⁹ Gérson Tontini, "Integrating the Kano Model and QFD for Designing New Products", *Total Quality Management & Business Excellence*, Vol. 18, Issue 6, 2007, s. 599-612.

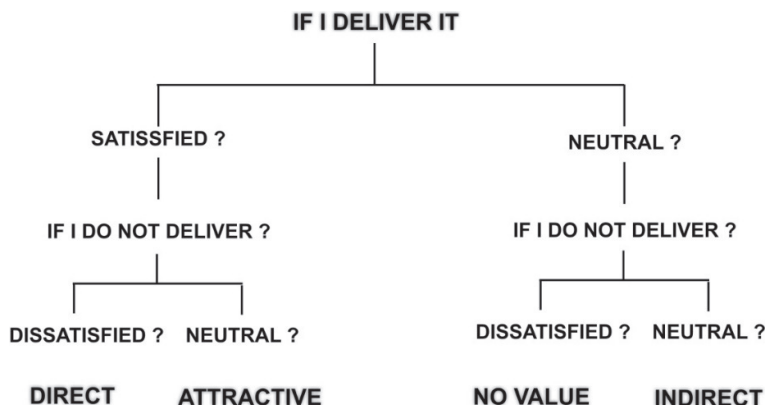
¹⁰ Yin C. Cheng and Tam, W.M., "Multi-models of quality In education", *Quality Assurance In Education*, Vol. 5, No. 1, MCB University Press 1997.

Noriaki Kano¹¹ observed that understanding what the client expects will allow the organization to focus on developing the right characteristics of the product or service (including the educational service). Such a view contributes to saving resources and transferring material and intangible assets, where they are needed at a given moment, to best serve the needs of a specific customer.

According to the theory of attractive quality, the relationship between the degree of sufficiency and customer satisfaction with a quality attribute can be classified into five categories of perceived quality:¹²

- Attractive quality attributes (A) provide satisfaction when fulfilled and no dissatisfaction when not fulfilled. These attributes are often referred to as surprise and delight attributes.
- One-dimensional quality attributes (O) provide satisfaction when fulfilled and dissatisfaction when not fulfilled.
- Must-be quality attributes (M) are taken for granted when fulfilled but result in dissatisfaction when not fulfilled.
- Indifferent quality attributes (I) are perceived as neither good nor bad and therefore do not result in customer satisfaction or dissatisfaction, i.e., these are quality attributes that customers do not care about.
- Reverse quality attributes (R) result in dissatisfaction when fulfilled and satisfaction when not fulfilled. For example, when you want a basic model of a product you will be increasingly dissatisfied the more functions it has.

Figure 1. Quality game¹³



¹¹ Noriaki Kano, Nobuhiko Seraku, Fumio Takahashi and Tsuji S. Shinichi, “Attractive quality and must-be quality”, *Journal of the Japanese Society for Quality Control*, (in Japanese), No. 14 (2), 1984.

¹² Ibid.

¹³ Dennis Lock, *Handbook of Quality Management*, Gower Publishing Ltd. 2003.

Determination of quality characteristics for defined attributes requires to carry out meticulous survey. One form of such research is use of so-called quality game to determine the nature of individual characteristics. Diagram of quality game is shown in Figure 1. Kano uses appropriate questionnaire that helps with use of researches carried out on clients to include particular feature to one of three main groups. In this method are examined customer's responses to researched feature. Client has two possible options:

- when given feature is present in product/service and functions normally,
- when given feature is not present in product/service or does not operate in satisfactory manner.

These questions are usually as follows:¹⁴

If a given feature occurs, how do you feel?

1. Suits me.
2. It has to be like this.
3. I do not care.
4. I can live with that.
5. It does not suit me.

Table 1. Determination of the type of feature in the Kano method

		Negative				
		Suits me	It has to be	I do not care	I can live with that	It does not suit me
Positive	Suits me	Q	A	A	A	O
	It has to be	R	I	I	I	M
	I do not care	R	I	I	I	M
	I can live with that	R	I	I	I	M
	It does not suit me	R	R	R	R	Q

Source: Hariharasudan and Sebastian Kot, "A scoping review on Digital English and Education 4.0 for Industry 4.0. Social Sciences, 7(11), 2018, pp. 0-13. <http://doi.org/10.3390/socsci7110227>

If a given feature does not occur, (or is not working properly), how do you feel?

1. Suits me.
2. It has to be like that.

¹⁴ Josip Mikulić i Darko Prebežac, "A critical review of techniques for classifying quality attributes in the Kano model", *Managing Service Quality*, Vol. 21, No. 1, 2011, s. 46-66.

3. I do not care.
4. I can live with that.
5. It does not suit me.

One variant treats feature in a positive way, and the other in negative. For each feature we receive combination of two answers. Each answer can take five values, in total we can receive twenty-five variants of combinations. Combinations are presented in Table 1.

4. TEST RESULTS

The research was carried out based on surveys using the google form among students and graduates of the first degree in the field of management and production engineering. In the case of employers, direct surveys supported by the interview were used. This approach was associated with the need to explain the descriptive concepts contained in the survey. For over half of the employers interviewed, the terms used were misunderstood or imprecisely interpreted. It also indicates a large gap in the preparation of the SME sector for transformation 4.0. The selection of the sample was purposeful, non-probabilistic. To the tests were qualified 96 student questionnaires, 60 questionnaires of graduates of first-degree studies in management and production engineering who continued their studies at the second-degree studies (36 questionnaires) and 21 employers from the small and medium-sized enterprises sector.

Table 2. The importance of quality attributes according to students, graduates and employers

Requirements	The number of votes in a given category [students/graduates /employers]					
	A	M	O	R	Q	I
1. Active teaching methods	-/-/	35/24/7	25/12/14	-/-/	-/-/	-/-/
2. Problem-based teaching	5/-/	16/27/18	39/9/3	-/-/	-/-/	-/-/
3. Lectures	-/-/	48/11/17	-/-/	-/1/-	4/8/2	8/16/2
4. Case study	7/-/	15/20/19	33/10/2	-/-/	-/-/	5/4/-
5. Multidisciplinary competences	11/12/5	15/16/5	25/5/10	-/-/	5/-/	4/3/1
6. Development of soft skills	3/5/7	20/12/6	8/14/8	-/-/	2/-/	5/5/-
7. Development of technical competence	-/-/	58/30/20	2/6/1	-/-/	-/-/	-/-/
8. Supporting advanced production systems	8/8/3	24/12/8	28/15/9	-/-/	-/-/	-/1/2
9. Supporting intelligent production concept	20/5/4	16/7/7	24/24/10	-/-/	-/-/	-/-/

Requirements	The number of votes in a given category [students/graduates /employers]					
	A	M	O	R	Q	I
10. Competence in big data	7/2/4	21/18/4	32/16/10	-/-/-	-/-/1	-/-/2
11. Competences in real time data / sensor	10/5/-	17/26/9	25/5/10	-/-/-	-/-/-	8/-/2
12. Competence in mobile applications	28/7/9	12/8/8	20/21/4	-/-/-	-/-/-	-/-/-
13. Supporting co-created product design & development	32/4/2	20/13/8	8/18/10	-/-/-	-/-/-	-/1/1
14. Support for cyber-physical systems	28/16/2	15/13/2	15/7/7	-/-/-	-/-/-	2/-/10
15. Support for modern maintenance systems	20/2/-	18/22/9	22/10/12	-/-/-	-/-/-	-/-/-

Source: Own research.

The first stage included an attempt to characterize educational services in terms of the expected method of transferring knowledge and the programming content directly related to Industrie 4.0. For this purpose, the experience from the implementation of the MSIE4.0-CBHE project and the market analysis for the necessary competences in the field of support for cyber-physical systems and support for modern maintenance systems were used to determine the features.

5. DISCUSSION

Based on the presented research results, it should be stated that the features that should absolutely be met in the students' opinion are: active teaching methods. However, it occurs between the expectations of first-degree students and second-degree students. This is related to the experience of second-degree students and greater expectations regarding learning methods as well as transmitted content (greater practical applicability). This is emphasized in the assessment of problem-based teaching as well as case studies and approaches to traditional lectures. Students indicate high expectations (M) in relation to active methods, problem-based teaching and case study, but do not attach so much importance to lectures (I) as first-degree (M) students. Active teaching methods in the characteristics of the quality of the educational service increase the student's satisfaction, and its lack causes dissatisfaction.

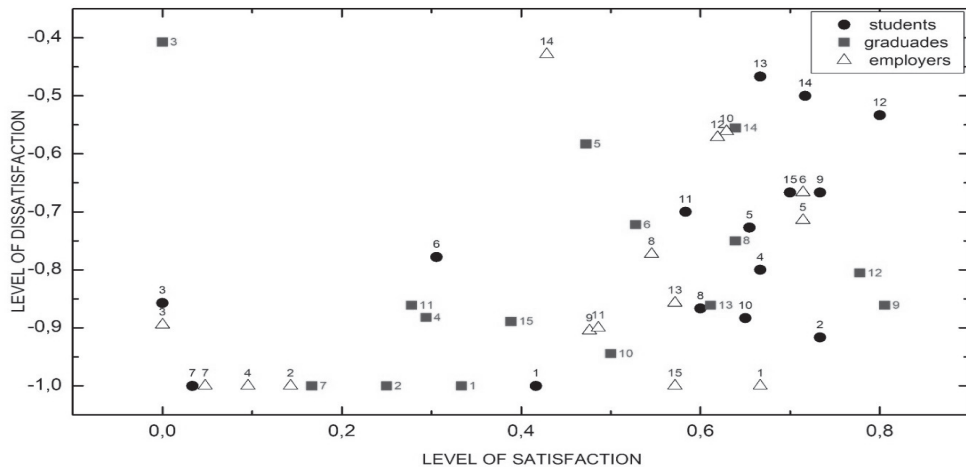
In order to determine the impact of particular features on the level of student/graduate/employer satisfaction, in case the required feature is met and has the level of dissatisfaction, if the characteristic was not met, formulas 1

and 2 were used.¹⁵ The obtained satisfaction level results for particular stakeholder groups are shown in Figure 2.

$$\text{level of satisfaction} = \frac{A+0}{A+0+M+I} \quad (1)$$

$$\text{level of dissatisfaction} = \frac{0+M}{(A+0+M+I) \cdot (-I)} \quad (2)$$

Figure 2. The level of satisfaction and dissatisfaction of students, graduates and employers



Source: Own research.

As the research results show, the highest degree of dissatisfaction among students/graduates and employers may occur in the case of lack of opportunities to develop technical competence (7) and in the absence of modern teaching methods based on active teaching methods (1), problem-based teaching (2). In addition, targeting subjects directly related to modern technologies (12) significantly affects the level of student satisfaction with the curriculum being implemented.

¹⁵ Charles Berger, Robert Blauth, David Boger, Christopher Bolster, Gary Burchill, William DuMouchel, Fred Pouliot, Reinhard Richter, Allan Rubinoff, Diane Shen, Mike Timko and David Walden, “Kano’s Methods for Understanding Customer defined Quality”, In: Center for Quality Management Journal, Vol. 4 (Fall 1993), pp. 3-36 and Elmar Sauerwein, Franz Bailom, Kurt Matzler and Hans H. Hinterhuber, “The Kano model: how to delight your customers, IX International Working Seminar on Production Economics, Innsbruck/Igls/Austria, Vol. 1, 1996, s. 313-327.

6. SUMMARY

The requirements posed by the industrial revolution 4.0 are very high and the demand for a new type of competence will be more and more dynamic. In front of universities, there is a huge challenge not only in the selection of material content and definition of learning outcomes but also in selection of form.¹⁶ The expectations of the client (student) are large, a traditional lecture is no longer attractive in terms of content distribution channel. What not only present the results of the presented study, but also the initial assumptions of the realized MSIE4.0-CBHE project. Shaping the right quality of educational service is essentially about shaping and modifying its individual features in relation to the market demand but also the student's need to have didactic material enabling interaction supported by case studies in which problem-based teaching is used. The conducted research and an interview with the employers of the small and medium sector showed the need to support this sector in the aspect of preparations for revolution 4.0.

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¹⁶ Duangthida Hussadintorn Na Ayutthaya and Pisut Koomsap, Assessment of student learning experience with “Love”, In Proceedings of INTED2017 Conference 6th-8th, Valencia, Spain, 2017, pp. 1973-1982; Duangthida Hussadintorn Na Ayutthaya and Pisut Koomsap, “An Application of ‘ LOVE ‘ Model for Assessing Research Experience”, In M. Peruzzini (Ed.), Transdisciplinary Engineering Methods for Social Innovation of Industry 4.0, 2018, (pp. 712-720). <http://doi.org/10.3233/978-1-61499-898-3-712> and Joanna Rosak-Szyrocka and Martyna Blašková, 2Engineering production education in e-learning example in Poland2, Production engineering Archives 12, 2016, pp. 42-45.

Abstract

KVALITETA OBRAZOVNIH USLUGA - ZAHTJEVI 4.0 INDUSTRIJE

Industrija 4.0 postavlja nove zahtjeve na tržištu rada, ali i na sveučilišta, a to je problem prilagodbe obrazovnih programa za zanimanja za koja još nisu definirane potrebne kompetencije budućih zaposlenika. Kano model korišten je u istraživanju, istraživanje je provedeno među studentima preddiplomskog studija, diplomiranim studentima i potencijalnim poslodavcima. Dobiveni rezultati ukazuju na jaz između očekivanja poslodavaca i studenata.

Ključne riječi: kvaliteta, visoko obrazovanje, servqual, Kano, industrija 4.0.

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