Quantitative Analysis of Educational Services for Innovative Marketing in Higher Education

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Abstract

Marketing has received increasing attention from higher education institutions due to the high level of competition in-between education establishments and wide spectrum of proposed educational services. To develop effective marketing strategy numerous investigations, comparisons, as well as quantitative estimations have to be done. We address the problem of quantitative estimation of educational services. The problem area is presented as logical part both of specific and common modern trends. This paper provides an integrative theoretical approach, that substantiate the central specific task of educational marketing and gives an example of the methodology supporting task solution.

Keywords

Educational marketing, Educational Service, Kansei Engineering, Statistical Learning Theory

1. Introduction

Recent years have seen a growing interest of marketing in education (Schmidt, 2007). The education market has developed as an attractive business and requires educational institutions to cope with modern marketing approaches. Orientation to the customer and satisfaction of their needs in receiving high quality education is a basis of effective activity of any education institution. In a competition for the customer, educational institutions compete first of all among themselves in ability to give to the customer the best high-quality educational service (Schmidt, 2007). In this context, educational marketing should actively develop in new directions, for example, to create qualitatively new educational services, which have the added value both for the customers and for the educational institution (DAAD, 2006). Educational services with new quality (new specialties, high level of knowledge, updated learning process, etc) should have impressive attitude from the customer. In this context more detailed research is required in such areas as a customer behavior (Kardes, 1999); decision making process concerning the choice of higher education institution (Sismeiro and Bucklin, 2004); model of reduction of the cognitive dissonance. These research areas deal with special features of educational services, which belong to different domains, such as psychology, philosophy, sociology, culture, etc.

Products in the modern market are very similar in price and characteristics and it is generally recognized that impressions from the products is becoming extremely important for differential advantage. Marketing should evoke the right feelings through the product design and positioning, it operates with concepts and ideas from psychology, art and culture. At the same time the role of exact quantitative analysis and computer simulation in marketing is of extreme importance. Real experiments are often impossible because of large the number of subjects (for example customer target groups). Modern marketing deals with intangible ephemeral categories (for example "value of educational service") that complicates the application of information technologies, realization of analysis and quantitative estimation. That is why new experimental investigations, predictions and quantitative comparisons are quite important. The relative novelty of educational marketing phenomenon means a serious lack of experience and knowledge exists. Strong demand exists for specific technologies and methods (Schmidt, 2007). There should be technologies that bridge the gaps between ephemeral categories from marketing (psychology, sociology, etc.) and possibilities of applied information technologies. We address these marketing research gaps by introducing an integrative theoretical approach that substantiates the central specific task of educational marketing and provides the methodology supporting task solution. Taking into account recent status of high education market the central problem of educational marketing can be formulated as: to introduce the educational services as the set of clear, attractive and important for the customer attributes. In connection with such a problem statement it is necessary to estimate a perceived value of educational service. It is not the actual, real value, but the mental structure which locates in a customer's mind and causes the purchase decision-making process concerning educational service. It is possible to say, that the perceived value of educational services is the main factor that determines the position of the higher educational institution in the market place. The customer himself can not express a degree of perceived value, and, especially, to give the quantitative interpretation to this phenomenon (Nagashima *et al.* 2008). But the value of a product perceived by the customers is very important information for experts in marketing, which allows them to position their services in the market most effectively. The following research problem has been proposed: how can the perceived value of the educational service be described? And to develop an approach that can quantitatively analyze response to educational services. This paper will specifically talk about the quantitative analysis of educational services that will largely focus upon the current state of the art.

The organization of this paper is as follows. The next section presents the common trends of nowadays science and state of the art. The third section discusses proposed methodologies and appropriate algorithms for defined problems solution. The last section summarizes and concludes the paper.

2. Background

2.1. Common trends

Nowadays stage the science evolution can be characterized by postmodernism spirit. It has reshaped all forms of the human activities and fixes the mental specificity of

society today. Practically all parties and aspects of modern life are involved in this cultural-philosophical trend. In his classical work "The Postmodern Condition: A Report on Knowledge" Jean Francois Lyotard connects evolution of cybernetics with occurrence of special "postmodernist" vision of the world (Emory University Web Site, 2008). The philosopher emphasizes, that the nature of knowledge cannot remain constant as general changes caused by rash progress of information technologies. The characters of knowledge are changed. The reality imitation takes on special significance. In the early 1980s Jaron Lanier introduced what has become a popular term "Virtual Reality" (Jaron Lanier's Web Site, 2007). The simulation of normal life activities became typically characteristic of modern society (for example e-learning). The way of thinking is changed. In a science real experiments are often replaced with experiments on models and simulations using information technologies. Computer simulation is one type of virtualization, which actively used in various areas of a science. This stage of a science evolution is characterized by the very good chance for humanitarians. Humanitarian science areas often have research objects as intangible, immeasurable concepts (culture, political attitudes, etc.) and often deal with complex systems (public classes, etc.). Realizations of real experiments in this condition are impossible or extremely complicated. As information technologies progress they provide new opportunities in the field of the analysis of complex systems and intangible objects. In this context the area of computer simulation looks very promising. Science reorients from subject to problem. A trans-disciplinary approach applying experiences from different areas is very popular today.

For a quantitative estimation of educational service value at the customer level a perceived value of educational service only can be taken into consideration. Investigations concerning this category, with attributes of postmodernist orientation of science: trans-disciplinarity, logic-linguistic structures, IT expansion in non technical disciplines, virtualization and so on are quite important and promising area for research. This work makes an attempt to connect the technical approaches with pure humanitarian ephemeral categories applying for education marketing.

2.2. State of the art

2.2.1. Formalization attempts

The impressions and feeling conceptualization and theirs quantitative analysis is not new area of research investigations (Vicarious Perception Technologies Web Site, 2007). Attempts have been done in different areas: psychology, sociology, marketing, medicine (Blecker *et al.* 2003). Today's instruments range from simple pen-and-paper rating scales to high-tech equipment that measures brain waves.

There are two main groups of instruments that measure feelings and emotions: non-verbal and verbal. The first group is language independent and based on physiology. For example, the instrument Face_Reader developed by Vicar Vision and Noldus IT can recognize a number of expressions in a facial image (Vicarious Perception Technologies Web Site, 2007). Despite having a range of advantages (independence from language, objectivity) this group of instruments do not fit to our research as

they have serious restrictions: limited number of studied emotions (six to eight basic emotions) and no possibility to analyze mixed feelings. Verbal instruments overcome these limitations.

In addition to above mentioned instrument groups there exists a range of approaches that try to measure feelings indirectly, based upon external analysis. For example a key metrics system developed to measure the level of Customers Happiness (Blecker *et al.* 2003):

Complaints rate at ΔT= (Number of complaints at ΔT)/(Number of deliveries at ΔT), Return Rate at ΔT = (Number of returned products)/(Number of delivered products), Customers Churn Rate at ΔT = (NOLC(ΔT))/(NOC(T) + NONC(ΔT) – NOLC(ΔT)). NOLC (ΔT): Number of lost customers at ΔT, NOC (T): Number of customers at T, NONC (ΔT): Number of new customers at ΔT. Based on above given system of numerical parameters it is possible to analyze a level of Customer Happiness.

2.2.2. Kansei Engineering

Conceptually closest to our approach is Kansei Engineering (METI Web Site, 2007). This approach has been offered in the 1970's by Prof. Nagamachi at Kure University (now Hiroshima International University) (Nagashima *et al.* 2008). Kansei Engineering formalizes such concepts as feelings, impressions, and emotions and highlights theirs role in the purchase decision-making process. Kansei Engineering tries to transform cognitive, mental structures in customers mind in products features. A new term "kansei value" is proposed, that is defined as the "… special type of value that is actualized when a product or service appeals to the kansei of ordinary citizens and arouses their emotions and empathy" (METI Web Site, 2007). The proper definition of word "Kansei" do not exists. The term came from Japanese and don't have unequivocal translation. "Kan" can be approximately translated as "sensitivity" and "Sei" as "sensibility" (Learn Sigma Web Site, 2008). Official term is "Kansei engineering", but in connection with translations difficulties it is often referred to as "Affective engineering" and "Affective design", especially in USA and Europe. Kansei (or affective) value defines products success. Convincing examples of Kansei engineering successes are: Mazda Miyata/MX 5 (with Guinness Record 2001 as the best sold sports coupe more then 10 years), Sharp video camcorder with LCD-display (with market share increase from 3 % to 24 %), underwear producing company Wacaol (42% market share in Japan) (Linkoepings University, 2008). There is a growing interest in Kansei Engineering in the world: it is widespread throughout Asia; In Japan is forming an academic network to maintain this trans-disciplinary research area and to join different research directions and groups; and in Europe there are also the groups developing this direction, for example "The Kansei Operations Center" at Linköping University in Sweden (Linkoepings University, 2008). The European project called "ENGAGE" started forming a knowledge community focused on affective design and affective engineering (Europa-CORDIS, 2007).

2.2.3. Research specificity

Kansei engineering transforms impressions, emotions in physical features of a product (LCD-display). This is the main difference from our case. Educational service is an ephemeral, complex product, is described and perceived much more complicated. Obviously, it is much easier to understand and to describe the categories "I have a car – I don't have a car" then categories "I have education – I don't have education". It is possible to describe education only using complex logic and linguistic structures. The formalization of affective value of educational service is complicated, as well as the further emotion implementation in an end-service. Despite the similarities of Kansei Engineering and our approach there are differences due to the feature and nature of object have to be analyzed. Affective value of educational service cannot be investigated completely within Kansei Engineering methodology. Some adaptations and improvements are needed. Nevertheless, considering conceptual affinity of Kansei Engineering to our research, it is supposed to use some ideas, developed within Kansei Engineering. Thus, using the terminology of Kansei Engineering, the term "affective value", meaning described above "perceived value" will be used.

3. Methodology

This section will describe the proposed research plan of the study. The first part is dealing with education service as a marketing category. Next part investigates high education parameters and arguments as the measurable characteristics of affective value of education service. For a data collection the Personal Construct Psychology approach is planning to be used. The modern approach from Statistical Leaning Theory, such as Support Vector Machines looks as good solution for statistical data investigation and can be used for software tool development.

3.1. Definition of problem area

This part is dealing with more precise and proper determination of research objects, subjects and categories. The main tasks of this part are to describe educational service as a marketing category, define the main subject, object and goal of educational marketing. Differentiation and specification of educational service concept is also needed. In short: we consider the students as the main subject of educational marketing activity, and educational service as the main object.

3.2. Parameters and arguments definition

To understand the phenomenon of educational service we should fix the main parameters that describe this category, as well as the arguments on which these parameters depend. For this purpose examine as an example some problem areas of educational marketing (Trajnev *et.al.* 2007):

1. The educational concept. The answer to this complicated question should define an optimum parity between fundamental and applied knowledge.

2. Teaching and control technologies. Alongside with traditional, academic form, extend team teaching, game forms, project forms and others. Knowledge can be supervised stage by stage, in a current or in a final mode.
3. Teaching technique. This question is close to the previous and defines which trainings approaches will be used. It can be an individual approach depending on students study character, a special way of visualization, etc.
4. Teaching form. Besides traditional academic form, it can be distance, extern, mixed and other forms.
5. Territorial aspect. It includes an opportunity of education in a partner institution (for example, a semester abroad), rendering of educational services on a place (seminars at firms with the purpose of professional skill improvement), etc.
6. Teaching staff and its functions. Here is defined the staff structure (professors, invited experts, etc.) and specified its functions (lecturing, supervises over the scientific or practical project, etc.).
7. Whom to teach? Only school graduates or to expand a contingent?

Many parameters of educational service are determined by these problem areas. Making a start from parameters of educational service it is possible to create logic-linguistic structure for the analysis of affective value. Within the structure it is necessary to estimate the importance of parameters and to range arguments. The parameters structure with defined interdependencies and their importance estimation represent the core of educational service. This structure defines further research activity and methodology.

To illustrate this idea a short example with two parameters can be made. Suppose we select “fundamental orientation” and “applied orientation” that clarify the aforementioned first problem area. The arguments that describe “fundamental orientation” are: presence of scientific schools in an educational institution and their representatives among teaching staff, an active student's scientific life and opportunity of Ph.D. study. For “applied orientation”: close contacts with firms, teaching on practical cases, practice during education. Thus, three arguments for each parameter have been chosen. This number results from the character of human perception: more than three arguments for each parameter make unnecessary in our case perception complications (Schuh, 1989).

3.3. Data Collection methodology

This part assumes the research of affective value of educational service at the mental level. The linguistic structure, describing educational service, is, in fact, system of stimulus. Reaction on this scheme reconstructs the mental structures of customers reflecting affective value of educational service. It should be developed the technique allowing to display mostly correct the customer’s mental structures corresponding affective value of educational service. This approach is based upon the classical scheme “stimulus → response” that illustrates the behavior of an individual. This scheme evolved from behaviourism and presents today almost in all psychological theories. The initial approach for this research is Personal Construct Psychology (PCP) developed by clinical psychologist George Kelly 50th years ago. PCP is

widely used in different research areas: management, psychology, pedagogy etc. The PCP approach is also used in marketing for market and customer behaviour research. For example for knowledge acquisition about desired product attributes (Reynolds and Gutman, 1988). Within this theory, a set of techniques named Repertory Grid Methods have been developed that study the personal system of meaning. These methods represent a basis for the development of our own methodology for data collection. Coming back to the previous example with the two parameters to help clarify; the simplest table illustrating a possible data extraction can be demonstrated:

Scientific schools and theirs representatives	Opportunity of Ph.D. study	Close contacts with firms	Teaching on practical cases	Practice during education	Active student's scientific life
3	2	6	5	4	1

Table 1: Example of questionnaire

This table represents quantitative estimations of arguments given by respondent. He should range the importance of arguments from 6 (most important) up to 1 (least important). The following basic idea from Repertory Grid Methods should be emphasized: the respondent does not know about researched parameters. He makes a parameter estimation being based on arguments and do not distort their own attitude to the parameter, as often happens by direct questions.

3.4. Developing the algorithm

The collected data, described in previous section, are not usually the results of a large number of observations. That is why for extracting the correct results from this data the classical statistical techniques can not be used. To overcome the problem of small sample statistics new approaches from *Statistical Leaning Theory*, such as *Support Vector Machines* can be used. The mathematical definition of results from collected statistical data is of extreme importance for further discussion. Numerous and different results are very useful for educational marketing. These results are necessary to increase the efficiency of educational services.

At this point let us concentrate our attention on the example of clustering the customers depending on their attitude to some parameters of educational services. In this paper two parameters, namely fundamental and applied orientation, have been chosen as an example (see part 3.3). Intuitively these two characteristics can be regarded as two parameters with opposite features. At the same time it is quite important to emphases that for some of the customers both fundamental and applied orientation is equally important. This example allows answer the following question: have the clusters (customer target groups) preferences to fundamental or applied education?

To determine the existence of two separate clusters of customers the statistical classification methods have to be used. For the case of small sample statistics the Support Vector Machines (SVM) is very productive and promising solution. Support Vector Machines allows classifying on two separate clusters the customers depending on their attitude to fundamental and applied orientation. All customers are

described by n-dimensional vectors $m=(m_1,\ldots,m_n)\in M\subset R^n$ have been obtained as an answer on question defining the arguments of two above mentioned parameters: fundamental and applied orientation (see Table 1). Coordinates m_i are the real numbers as the expected answers representing the arguments of above mentioned parameters. Based on these vectors the following linear threshold classifier can be constructed:

$$F(M)=sign\left(\sum_{i=1}^{n} w_i m_i - w_0\right) \quad (1)$$

The vector $m=(m_1,\ldots,m_n)$ can be regarded as an input values for simplest neuron model proposed by McCulloch and Pitts (Vapnik, 2006), (wm) is the product of two vectors $w=(w_1,\ldots,w_n)$ and $m=(m_1,\ldots,m_n)$ and w_0 is a threshold value. The output takes two values $F(M)\in\{-1,1\}$ that allows to make the customer classification into two clusters. If $(wm)-w_0>0$ then $F(M)=1$ and $F(M)=-1$ if $(wm)-w_0\leq 0$. The neuron (1) divides the space M into two clusters, these regions are separated by the hyperplane $(wm)-w_0=0$. The coefficients w_i, $i\in\{0,1,\ldots,n\}$ of neuron can be obtained during the learning process. In the case of SVM the hyperplane is found in optimal way, which leads to more accurate classification comparing to classical models (Vapnik, 2006).

Based on a classifier for all customer clusters it is possible to obtain the sets of metrics which express the customer's attitude to all parameters of educational service. To simplify the following discussion let use the normalized metrics P_i, $i\in\{1,\ldots,l\}$, $(0\leq P_i\leq 1)$. In case of the aforementioned example of two parameters, two metrics P_1 and P_2 will be generated as the ratio of customers from predicted cluster with positive attitude to fundamental or applied orientation to the entire number of customer have been questioning from this cluster. For example, in a case of young customers, without practical experience and with high motivation to get the job the value of the second metric P_2 can be sufficiently higher comparing with P_1. For example, P_1=0,9 and P_2=0,1. For another cluster with equal attitude to this two parameters $P_1=P_2$=0,5.

The numerical values represented as the set of metrics P_i, $i\in\{1,\ldots,l\}$ for various customer clusters are very important for educational marketing. In a case of a higher educational institution with applied orientation, the marketing activity will have to be directed to the customer clusters with high values of metric P_2. At the same time the marketing promotion should not be oriented on customer clusters with small value of P_2. Even for this very simple example another set of metrics have to be introduced. This set P^*_i, $i\in\{1,\ldots,l\}$, $(0\leq P^*_i\leq 1)$ formally describes the efficiency of some particular higher educational institution. These metrics have to represent adequately how some higher education institution can satisfy all parameters. Obviously, for higher education institution with applied orientation P^*_2 should be very close to 1, and P^*_1 takes small value. Metrics P^*_i are also generated based on statistical data, which have to be obtained from insiders, for example, graduate students, administration of this institution and staff (professors, PhD student, lectures and so on). In a case of one parameter for the estimation of the efficiency of educational services there are no complex marketing problems. The decision making procedure

consists of a comparison of metric P_i for some customer cluster with P^*_i. In reality this comparison is numerical estimation how the higher education institution can satisfy concrete customer's feelings, expectation or willing (parameter of educational service).

Significantly a different situation arises for the general case when the higher education institution is described by l metrics P^*_i, $i \in \{1,\ldots,l\}$ and all customer clusters are represented by their own set of metrics P_i, $i \in \{1,\ldots,l\}$. First of all it should be noted that two different metrics P_i and P_j which represent customer's attitude as well as P^*_i and P^*_j institution possibility can have sufficiently different importance and meaning for customers. For example, for some customer clusters more important to get applied oriented education, that is why this metric P_2 must have the higher weight comparing with another metrics not only with P_1. To make differentiation among the metrics the vector $v=(v_1,\ldots,v_l)$, $(0 \le v_i \le 1)$ of weights have to be used. Based on this vector the sets of weighted metrics $Q=(vP)=(v_1P_1,...,v_lP_l)$ for customer's cluster and $Q^*=(vP^*)=(v_1P^*_1,...,v_lP^*_l)$ for institution are calculated. The weights can be obtained from the same statistical data as expert estimation.

Making the decision which customer clusters are more promising and motivated to get the education in some higher education institution two sets of metrics $Q=(Q_1,\ldots,Q_l)$ and $Q^*=(Q^*_1,\ldots,Q^*_l)$ have to be compared. The simplest solution that can be achieved based on analyses of one characteristic D, calculated as

$$D = \sqrt{\left(Q_1 - Q^*_1\right)^2 + \ldots + \left(Q_l - Q^*_l\right)^2} \quad (2)$$

This characteristic D takes the value from $D_{min}=0$ to $D_{max} \le \sqrt{l}$. In a case D_{min} the customers expectation and feelings expressed as the set of weighted metrics Q one to one satisfies the higher education facilities (educational service) described by Q^*. This is the case for active marketing policy with the clusters described by the weighted metrics $Q=Q^*$. For the case D_{max} the facilities proposed by institution are completely different comparing with customers feelings about educational service.

4. Conclusion

It should be emphasized that this paper presents the work in progress and describes the general concept of the research to be undertaken. Further efforts will be focused on a detailed development of parameter structure describing the educational services. Furthermore, significant focus will be given to how to adapt the methods of Kansei Engineering and Personal Construct Psychology approach to this research and to improve data collection methodology. These steps will provide a mathematically connection between the mental structures defining the affective value of educational services and instrumental tools supporting the decision making process in the area of educational marketing. Adopting techniques previously described, formal mathematical approaches for educational marketing will be utilized, enabling appropriate software tools to be designed and developed to simplify the decision making procedure for marketing departments of higher education institutions.

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