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USING A MULTI CRITERIA DECISION MAKING APPROACH FOR OPEN AND DISTANCE LEARNING SYSTEM SELECTION

ABSTRACT

Today, there's a wide variety of open and distance learning (ODL) systems around the world. Herein, for lifelong learning how to select an ODL program becomes a critic question for a learner who wants to extent abilities on his/her career path. This is a complex decision problem with interdependent criteria. The Analytic Network Process (ANP) is a multicriteria decision making methodology that reflects these interdependencies. Within the ANP networks of influence one includes all the factors and criteria, tangible and intangible, which have bearing on making a best decision. In this paper, an ANP model is constructed to search out and prioritize the criteria affecting these ODL systems and to help learners in selecting a program. It's concluded that the Bachelor's degree programs are the most preferred ones. In addition, this model will help the institutions in the regard of which criteria are prominent in terms of different programs. Therefore, this study will support the institutions in regard to ODL policy development**.**

Keywords: Analytic Network Process, E-learning, Open and distance learning, Multiple criteria analysis, Policy development.

AÇIK VE UZAKTAN EĞİTİM SİSTEMİ SEÇİMİ İÇİN ÇOK ÖLÇÜTLÜ BİR KARAR VERME YAKLAŞIMININ KULLANILMASI

ÖZ

Bugün, dünya çapında çeşitli açık ve uzaktan eğitim (ODL) sistemleri bulunmaktadır. Bu noktada, yaşam boyu öğrenme kapsamında kariyer yolundaki yeteneklerini geliştirmek isteyen bir öğrenen için bir ODL programını nasıl seçeceği önemli bir soru haline gelmektedir. Bu ise birbirine bağlı ölçütlerden oluşan karmaşık bir karar problemidir. Analitik Serim Süreci (ANP) , bu bağlılıkları ele alan çok ölçütlü bir karar verme yöntemidir. ANP'deki serimler en iyi kararı vermek için hem nitel hem de nicel tüm faktör ve ölçütleri içermektedir. Bu çalışmada, ODL sistemlerini etkileyen ölçütleri araştırmak ve önceliklendirmek ile öğrenenlere bir ODL programı seçiminde yardımcı olmak amacıyla bir ANP modeli kurulmuştur. Çalışma sonucunda, lisans programları en çok tercih edilen ODL programı olmuştur. Ayrıca önerilen ANP modeli, her bir program türünün yürütülmesi için hangi ölçüt ve/veya ölçütlere dikkat edilmesi konusunda da uzaktan eğitim kurumlarına yardımcı olacaktır. Bu nedenle bu çalışma, ODL politikası geliştirme açısından da kurumlara destek verecektir.

Anahtar Kelimeler: Analitik Serim Süreci, E-öğrenme, Açık ve uzaktan öğrenme, Çok ölçütlü analiz, Politika geliştirme.

JEL classification: C63, I23

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1. INTRODUCTION

Lifelong learning is very important for learners especially for the ones who wants to extent abilities on his/her career path. In the recent times, many educational institutions offer e-learning courses or open and distance learning (ODL) programs for the learners.

As Daniel (1995) mentioned, spurred by continuing growth in the demand for education, especially among adults, teaching and training institutions of all types are exploring and adopting the methods of ODL. Thus, so many e-learning options arise and a program selection and/or evaluation problem occurs. As stated in Pirraqlia (2009), evaluating online schools is not unlike analysing on-campus institutions, but much less costly and time consuming. Instead of spending time and money to traveling and visiting on-campus schools, evaluating an online university or college can be accomplished from the comfort of one's home. However, there are many tangible and also intangible criteria that affecting each other to be considered. From this point, selecting an ODL program becomes a multi criteria decision making problem.

Multi criteria decision making (MCDM) is widely used in ranking or selecting one or more alternatives from a set of available alternatives with respect to multiple, usually conflicting tangible and intangible criteria. In MCDM theory the general assumption is to assume that the criteria are independent. This makes optimal MCDM solutions less useful than they could be and a decision maker who accepts an optimal solution from the model cannot be sure that he has made the correct trade-offs among the objectives. In the literature it is widely recognized that in many decisional problems criteria are interdependent. The MCDM methods that involve multiple, and usually conflicting criteria allow decision makers to deal with complex evaluation problems to achieve a certain goal. Among these MCDM models, the Analytic Hierarchy Process (AHP) and the Analytic Network Process (ANP) are widely used methods to solve such problems (Perçin 2010).

Depending on the today's changing and developing conditions, different educational needs arise. Accordingly, educational institutions try to offer different types of programs. These program types construct the alternatives of this study. The purpose of this paper is twofold. The primary objective of the study is to develop an ANP model to determine the criteria of the open and distance education program components and to determine weights of the alternative programs. The model has eight clusters (main criteria). All the participants and the criteria with their interrelations are defined. Relative weights are obtained for the criteria and alternatives in the ANP model by using the Super Decisions software. Secondly, this paper identifies and structures a framework to assess an open and distance institution's education strategy. This framework will help administrators in evaluating their open and distance programs.

The rest of paper is organized as follows. A review of MCDM problems in educational systems are given in Section 1. Section 2 gives brief information about the ANP and the proposed ANP model for the open and distance program selection problem are given in Section 2 and 3, respectively. The model is applied to a real system; in Section 4 the conclusions are given.

2. REVIEW of MCDM PROBLEMS in EDUCATIONAL SYSTEMS

According to Ertugrul and Karakasoglu (2007), in future studies multi criteria methods can be applied to multi criteria decision problems of the universities. There are some related studies that use MCDM techniques for ODL problems in the literature. Poonikom et al. (2004) has proposed a systematic framework using ANP for the selection of universities that offer undergraduate program in engineering. An advantage of this approach lies in its ability to link, dynamically, economic, cost and risk factors. Chao and Chen (2009) propose a simple and easy method to weight the factors in an e-learning program or system and then evaluate the overall e-learning effectiveness. They use consistent fuzzy preference relations in an AHP structure to find the weight of the affecting criteria in a distance e-learning system. Sadi-Nezhad et al. (2010) evaluate three e-learning systems in Iran by using ANP and fuzzy preference programming.

Girginer et al. (2007) developed an ANP model to select a courseware development platform for distance education systems. Ozkul et al. (2007) as for that, developed an AHP model to evaluate distance education implementation models in the case of Program in English Language Teacher Training (ELTT) in Anadolu University Open Education Faculty.

Shee and Wang (2008), proposed an adjusted AHP from the perspective of learner satisfaction to support evaluation-based activities taking place at the pre- and post-adoption phases of the web-based e-learning system (WELS) life cycle. Zhao and Shao (2010) discussed the application of ANP in evaluating assets management of the institution of higher education through establishing evaluation index system and confirming the weight of every index. In accordance with the potentially numerous criteria useful in evaluating innovation performance in higher educational institutions, Chen and Chen (2010) have combined DEMATEL, fuzzy ANP and TOPSIS approaches to develop an innovation support system that considers the interdependence and relative weights of each measurement criterion and different types of universities. Lesmes et al. (2009) applied ANP to establish weights in order to re-accredit a program of a university. Wang and Hsu (2010) proposed twenty-five criteria to assess the quality of e-learning. The AHP is the proposed method to analyze the nature of hierarchical structure.

3. METHODOLOGY: ANALYTIC NETWORK PROCESS (ANP)

Everybody makes decisions all the time, educated or uneducated, young or old, with ease or with great difficulty. We need to understand and organize our thinking to make better decisions. People believe that the most serious objection to quantification is that there are things which cannot be compared. However, quantity is not intrinsic to the things quantified but to the operations associated with quantification. The need to compare two things is the need to find a common denominator for them. A person may not be schooled in the use of numbers but still have feelings and understanding that enable him or her to make accurate comparisons. Such judgments can be applied successfully to compare stimuli that are not to disparate in magnitude. The Analytic Hierarchy Process (AHP) provides us with the way to derive from observer's quantified judgments, a set of weights or priorities to be associated with individual stimuli (Sağır Özdemir 2003). AHP is a theory that depends on the values and judgments of individuals and groups. It is used to derive ratio scales from both discrete and continuous pairwise comparisons in multilevel hierarchic structures.

Many decision problems cannot be structured hierarchically because they involve the interaction and dependence of higher-level elements on lower-level elements. Not only does the importance of the criteria determine the importance of the alternatives as in a hierarchy, but also the importance of the alternatives themselves determines the importance of the criteria. Hence, the Analytic Network Process (ANP) is a generalization of the AHP. The ANP feedback approach replaces hierarchies with networks. This network term means the interaction (interdependency) between criteria. The ANP is a theory of measurement generally applied to the dominance of influence among several alternatives with respect to an attribute or a criterion. ANP is also applied to evaluate the dominance of criteria with respect to a higher criterion and it is applied to evaluate alternatives with respect to a governing criterion (Saaty 1996).

The structure of the ANP model is described by clusters of elements connected by their dependence on one another as given in Figure 1. Here, we exhibit a hierarchy and a network. As it's known, a hierarchy is comprised of a goal and of levels of elements and connections between these elements. The connections are oriented only to elements in lower levels. A network has clusters of elements, with the elements in one cluster connected to elements in another cluster (outer dependence) or within the same cluster (inner dependence). A hierarchy is a special case of a network with connections going only in one direction. For instance, the arc from cluster 4 to cluster 1 indicates the outer dependence of elements in cluster 4 on the elements in cluster 1 with respect to a common property. Also the loop in a cluster indicates an inner dependence of the elements in that cluster.

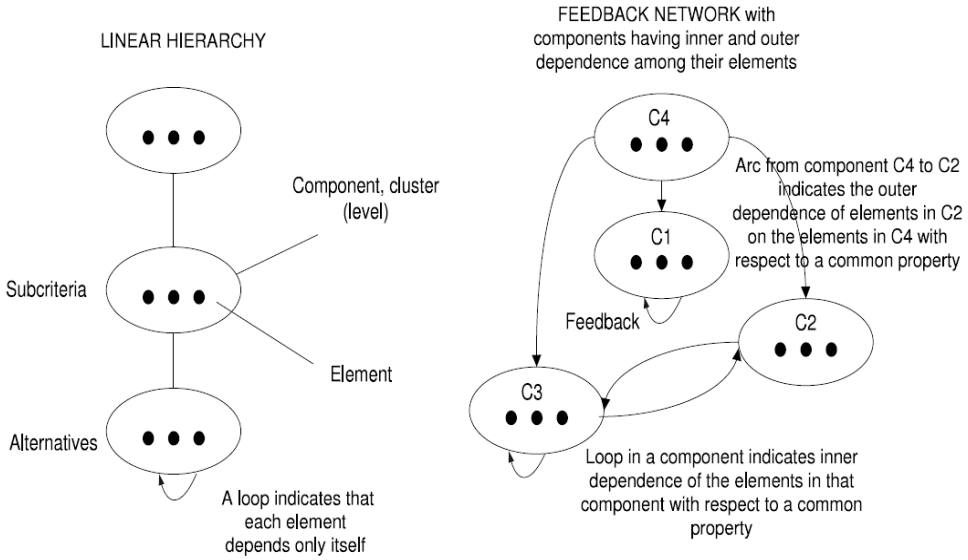

Figure 1: How a hierarchy compares to a network

The ANP is the first mathematical theory that makes it possible for us to deal systematically with all kinds of dependence and feedback. The reason for its success is the way it elicits judgments and uses measurement to derive ratio scales. This scale has been derived through stimulus response theory and validated for effectiveness, not only in many applications by a number of people, but also through theoretical justification of what scale one must use in the comparison of homogeneous elements (Saaty, Vargas 2006). The fundamental scale of absolute values for representing the strength of judgments is shown in Table 1.

Table 1. The fundamental scale

Intensity of Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective
3	Moderate importance	Experience and judgment slightly favor one activity over another
5	Strong importance	Experience and judgment strongly favor one activity over another
7	Very strong or demonstrated importance	An activity is favored very strongly over another; its dominance demonstrated in practice
9	Extreme importance	The evidence favoring one activity over another is of the highest possible order of affirmation
2,4,6,8	Intermediate values	

The process of ANP comprises four major steps (Meade, Sarkis 1999; Saaty 2001):

Step 1. Model construction and problem structuring: The problem should be stated clearly and decomposed into a rational system like a network. The structure can be obtained by the opinion of decision makers through brainstorming or other appropriate methods.

Step 2. Pair-wise comparisons matrices and priority vectors: Decision elements at each cluster are compared pairwise with respect to their importance towards their control criterion, and the clusters themselves are also compared pair-wise with respect to their contribution to the

goal. Decision makers are asked to respond to a series of pairwise comparisons where two elements or two clusters at a time will be compared in terms of how they contribute to their particular upper level criterion. In addition, if there are interdependencies among elements of a cluster, comparisons also need to been created, the eigenvector can be obtained for each element to show the influence of other elements on it. The relative importance values are determined with a scale of 1 to 9, where a score of 1 represents equal importance between the two elements and a score of 9 indicates the extreme importance of one element (row component in the matrix) compared to the other one (column component in the matrix). Pairwise comparison is made in the framework of a matrix, and a local priority vector can be derived as an estimate of relative importance associated with the elements (or clusters) being compared by solving the related equations.

Step 3. Supermatrix formation: The supermatrix concept is similar to the Markov chain process. To obtain global priorities in a system with interdependent influences, the local priority vectors are entered in the appropriate columns of a matrix, known as a super matrix. The supermatrix is raised to limiting powers to calculate the overall priorities, and thus the cumulative influence of each element on every other element with which it interacts is obtained (Saaty, Vargas 1998). The supermatrix of a hierarchy with three levels is as given in equation 1:

$$W = \begin{matrix} Goal \\ Criteria \\ Altervatives \end{matrix} \begin{pmatrix} 0 & 0 & 0 \\ w_{21} & 0 & 0 \\ 0 & w_{31} & I \end{pmatrix} \tag{1}$$

where w_{21} is a vector that represents the impact of the goal on the criteria, w_{32} is a matrix that represents the impact of the criteria on each of the alternatives, and I is the identity matrix. The supermatrix of a system of N clusters is denoted as given in equation 2:

$$W = \begin{array}{c} \\ e_{11} \\ C_1 \quad e_{12} \\ \vdots \\ e_{1n_1} \\ e_{21} \\ \quad e_{22} \\ C_2 \quad \vdots \\ e_{2n_2} \\ \vdots \quad \vdots \\ e_{N1} \\ C_N \quad e_{N2} \\ \vdots \\ e_{Nn_N} \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \dots & C_N \\ e_{11}e_{12}\dots e_{1n_1} & e_{21}e_{22}\dots e_{1n} & \dots & e_{N1}e_{N2}\dots e_{Nn_N} \end{array} \\ \begin{bmatrix} W_{11} & W_{12} & & W_{1N} \\ & & \dots & \\ W_{21} & W_{22} & & W_{2N} \\ \vdots & \vdots & \ddots & \vdots \\ W_{N1} & W_{N2} & \cdots & W_{NN} \end{bmatrix} \end{array} \tag{2}$$

As a result, a supermatrix is actually a partitioned matrix, where each matrix segment represents a relationship between two nodes (components or clusters) in a system. Let the components of a decision system be C_k, k=1,.., m, and each component k has m_k elements, denoted by $e_{k_1}, e_{k_2}, \dots, e_{k_{m_k}}$. The local priority vectors obtained in Step 2 are grouped and located in appropriate positions in a supermatrix based on the flow of influence from a component to another component, or form a component to itself as in the loop. For example, the component (C1) in the supermatrix includes all the priority vectors derived for nodes that are ``parent" nodes of the (C1) cluster, which means the elements in (C1) influence some or all the elements that feed into (C1).

In the ANP we look for steady state priorities from a limit supermatrix. To obtain the limit we must raise the matrix to powers. The limit may not converge unless the matrix is column stochastic that is each of its columns sums to one. To ensure stochasticity of the matrix, one needs to compare the influence of all the clusters on each cluster with respect to the

control criterion that underlies the comparisons from which the priorities in the supermatrix are derived. Powers of the matrix capture all transitivities of an order that is equal to the corresponding power of the supermatrix. All order transitivities are captured by the sequence of powers of the matrix. The limit of the priorities obtained by summing and normalizing the rows of each power and then taking the average of the resulting vectors, according to Cesaro Summability, is simply equal to the priorities derived from the limit of the powers of the supermatrix. The outcome of the ANP is nonlinear and complex.

Step 4. Selection of best alternatives: If the supermatrix formed in Step 3 covers the whole network, the priority weights of alternatives can be found in the column of alternatives in the normalized supermatrix. On the other hand, if a supermatrix only comprises of components that are interrelated, additional calculation must be made to obtain the overall priorities of the alternatives. The alternative with the largest overall priority should be the one selected.

4. THE ANP MODEL for THE OPEN and DISTANCE PROGRAM SELECTION PROBLEM

When a learner wants to select an open and distance learning program, according to his/her educational goals he/she has to consider some criteria that have dependence in each other. Beside these goals, there are also some tangible and intangible criteria effecting an open and distance education system. In this regard, an ANP model is constructed to analyze an open and distance learning system and the critic factors affecting the system are determined. Here, the kinds of programs are handled as the alternatives of the model. By this way, the program types can be evaluated and also the relative priorities of them will be obtained.

In an attempt to provide a pedagogical foundation as a prerequisite for successful e-learning implementation, Govindasamy (2002) discussed seven e-learning quality benchmarks namely, institutional support, course development, teaching and learning, course structure, student support, faculty support, and evaluation and assessment. Selim (2007) has intended to specify e-learning critical success factors (CSFs) as perceived by university students. The published e-learning critical success factors were surveyed and grouped into 4 categories namely, instructor, student, information technology, and university support. The categorization was tested and the results revealed 8 categories of e-learning CSFs. Confirmatory factor modeling approach was used to assess the criticality of the measures included in each CSF category. Sun et all. (2008) has also made an empirical investigation of the critical factors influencing learner satisfaction in e-learning. Their study developed an integrated model with six dimensions: learners, instructors, courses, technology, design, and environment. The model developed by Sadi-Nezhad et al. (2010) has four main dimensions including: Learner Interface, Learning Community, System Content and Personalization. Each dimension has its criteria, for example, System Content has three criteria including: Up-to-date content, sufficient content, and Useful content. As can be seen from the examples given above, a successful e-learning depends on many criteria, which can be found in e.g. Govindasamy (2002), Ong et al. (2004), Selim (2007), Sun et al. (2008), Tzeng et al. (2007), Wang (2003) and Wang et al. (2007).

4.1. Definition of The Criteria

A single level but detailed network model is developed to prioritize the alternatives of the selection problem. Here, under the goal of selecting the appropriate open and distance program, a network model is developed to prioritize the open and distance learning program types. In Figure 2, the model structure which was constructed in Super Decisions software is given. Clusters that have any links to their factors from the factors in a given cluster give the dependency between criteria. The program types are listed in alternatives cluster as: (1) Associate, (2) Bachelor's, (3) Master, (4) Doctorate, and (5) Certificate. The alternatives are determined according to the lifelong learning manner. A learner who has at least a bachelor's degree can select one of these alternatives.

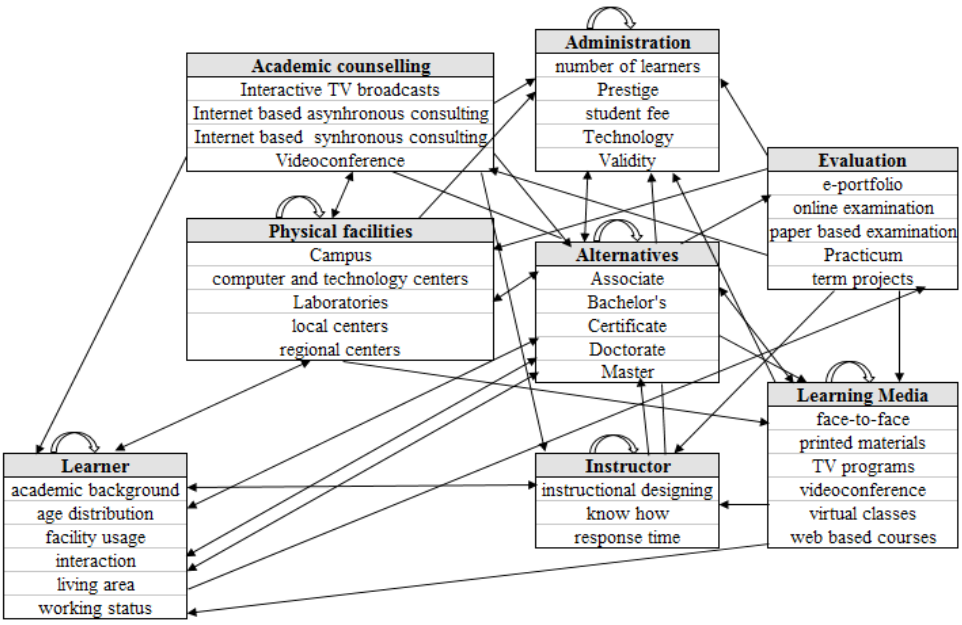

Figure 2. The ANP model

After the literature review and experts' opinions, the main criteria that must be considered are determined as learning media, academic counselling, evaluation, physical facilities, learners, instructor, management, and alternatives. Each criterion has some sub-criteria that also affect the system and the alternatives. All criteria and their sub-criteria are briefly explained as follows:

Learning media: Open and distance education systems provide the learners time and space independency. Thereby, the learners can join the lessons wherever they are and reach the lesson's materials whenever they want. At this point, the learning media comes into prominence at providing efficient and effective learning environment. So, the program's various learning media types becomes one of the important issue at the program selection stage. While the rates of utilization vary from one institution to another, web-based courses, virtual classes, videoconference, TV programs, printed materials, and face-to-face are common media almost in all open and distance education systems. So the learning media sub criteria are defined as follows: (1) Web-based courses, (2) Virtual classes, (3) Videoconference, (4) TV programs, (5) Printed materials, and (6) Face-to-face.

Academic counselling: Even if the learning materials are organized based on individual learning principles, there is always a need for learners to find someone to find answers and discussing. So in this manner, academic consulting is one of the important issue in open and distance education. The common counselling services can be listed as follows: (1) Internet based synchronous consulting, (2) Internet based asynchronous consulting, (3) Interactive TV broadcasts, (4) Videoconference, and (5) Face-to-face consulting. These five types of services are dealt as sub criteria of academic consulting criteria. Here it shouldn't be forgotten that, beside the four sub criteria, face-to-face consulting services should be pursued as wide as possible in the education area for the learners' accessing opportunity.

Evaluation: The success of any open and distance learning course depends on how well it is designed, executed, and evaluated. According to Gaba and Dash (2004), evaluation of a course not only demonstrates its strengths, but also points out any inherent shortcomings in the course. This is why course evaluation constitutes an important function in an open and distance learning system. The following evaluation types can be used with different ratios in an open and distance learning system: (1) E-portfolio, (2) Paper passed examination, (3) Online examination, (4) Term projects, and (5) Practicum.

Physical facilities: Although the importance of time and space independency feature of open and distance systems, physical facilities have a substantial role. For instance, for some programs like chemistry, biology etc. laboratories are a necessity. Beside the web based simulations, physical laboratories can be used. Also, local and/or study centres supports the learners' study environments. In addition, the distance of study centres from the learners' residences deduces the importance of local/regional centres. Based on these issues the sub criteria are determined as follows: (1) Local centres (2) Regional centres, (3) Computer and technology centres, (4) Campus, and (5) Laboratories.

Learner: In the field of learner, the open and distance program is directly related to some learners' properties. Besides these criteria interaction between the learners and learning platforms and/or instructors is also affecting the learners' success. So, the learner criterion has two main criteria as interaction and properties.

The related platform must include the components that satisfy the interaction of the learners (course content, interaction with other learners and with the instructors). Learners can access to appropriate data, databases (in or out of the campus), linking of courseware, guided decision groups. Beside these factors, some online courses have one or more prerequisite requirements. In addition, as Selim (2007) mentioned, student prior IT experience such as having a computer at home and attitude towards e-learning is also critical to e-learning success. Prerequisites can include the completion of a previous online course, basic computer knowledge, experience sending and receiving emails, the ability to download files, bookmark internet pages as well as attach and send documents over the internet. Based on these explanations, the criteria related to the learner properties are defined as (1) Living area, (2) Working status (3) Academic background, (4) Age distribution, and (5) Facility usage.

Instructor: Faculty members have always had a significant, but unique, role within distance education form. In the study of Milheim (2001), the following instructional activities for faculty involved with distance education are described: Coaching students throughout the learning process; focusing on the instructional process in addition to the educational content; encouraging students to be active learners; designing and guiding experiences and activities; and providing explanations, references, and reinforcement. Considering these activities, the sub criteria of instructors are determined as: (1) Instructional designing, (2) Response time, and (3) Know how.

Administration: Open and distance education is getting more dependent on information and communication technology than ever before. So, it's crucial for administrators to keep pace with the technology. Beside the technological issues, the prestige of the institutions plays an important role in the program selection phase. It's also important to take a valid degree. Finally, number of learners gives some hints about the programs. Therefore, the sub criteria related to administration are given as follows: (1) Validity of degree/diploma/certificate, (2) Prestige, (3) Technology, (4) Number of learners, and (5) Student fee.

In this section, firstly the interrelationships among criteria with respect to the goal and the interrelationships among detailed criteria with respect to an upper level criterion are considered. For instance, a doctorate alternative is affected by the other programs. If an institution has an experience on the other program types, this experience will be reflected to the doctorate program's application success. Comparably, other program types have the same interaction between each other. On the instructor side, for instance, instructors' instructional designing property is directly related to the instructors' know how. When the definition of the main and sub criteria is completed, all of these connections among them are determined. An example is given in Figure 2, when the mode to examine the connections is selected for doctorate in the alternatives cluster. The elements framed in bold colour in other clusters are those defined as the influencers of the selected criterion.

4.2. Pairwise Comparisons

After the construction of the network, paired comparisons are performed to set the priorities among the five alternatives and obtain the relative priorities of the elements and clusters. These comparisons are performed by entering judgments including all clusters and nodes, and the estimated weight of each criterion and alternative programs are obtained in the Super Decisions environment.

In this study, based on the lifelong learning manner the alternative programs are determined as the programs that can be selected by a learner who has at least a bachelor's degree. So, the evaluation is carried out by a group of 40 learners who are senior class industrial engineering students, engineers from different working areas (banks, hospital, industry and tourism), science and social science graduates. A questionnaire is prepared for all pairwised comparisons based on the ANP model. A sample question in this questionnaire is given as follows:

Q1. Based on "facility usage" criteria give points to learner's "academic background" and "age distribution" between "1" and "9" according to their preferability levels (9 for most preferred and 1 for least preferred one)

Academic background ☐
Age distribution ☐

Decision group members replied to the questionnaire and the pair wise comparisons are converted to the local weights Finally, the judgments of each expert are synthesized using the geometric mean approach. The learners made the pairwise comparisons and these comparisons are converted to the local weights. Finally, the judgments of each learner are synthesized using the geometric mean approach.

In the comparisons, firstly the criteria are compared with respect to each alternative. Here, two types of questions are asked: (1) Which of the alternatives satisfies a criterion more? (2) Which of the two criteria is more characteristic of a given alternative? The preference levels for the criteria change from one learner to another. Naturally, if a criterion is more desirable or positively affects the learner, it will take a higher weight. As an example Figure 3 gives a screen view of the pairwise comparisons of nodes that must be compared for their impact on the alternatives. For the given criterion "computer and technology centres", it's asked that which of the two open and distance program has more effect on computer and technology services Doctorate or Master, and how much more? And the first answer is given as Doctorate is 3 times much more affecting the computer and technology services.

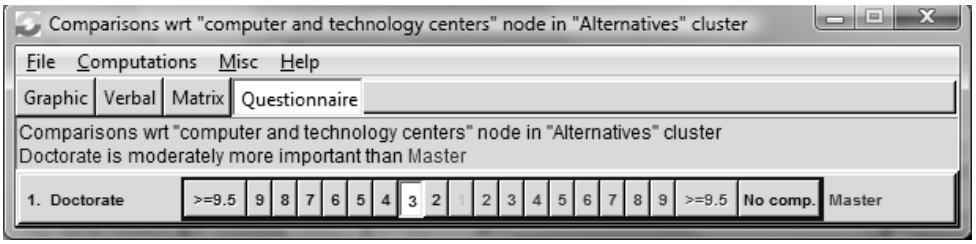

Figure 3. Pairwise comparisons of nodes in the same cluster

As another example of node comparisons, in Figure 4 we give the judgment for "learner's academic background" versus "age distribution on facility usage". According to the comparison, it is more important to have an academic background on facility usage.

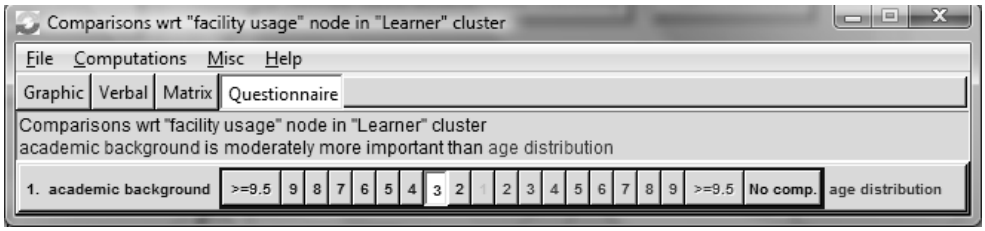

Figure 4. Pairwise comparisons of nodes

Clusters that have any links to their elements from the elements in a given cluster must be compared for their impact on the given cluster (Sagir, Ozturk 2010). For instance, according to the comparison given in Figure 5, the "Learning media" cluster has a four times greater effect on the "Academic counselling" cluster than does the "Administration" cluster. All of the comparisons in this study are done as this way.

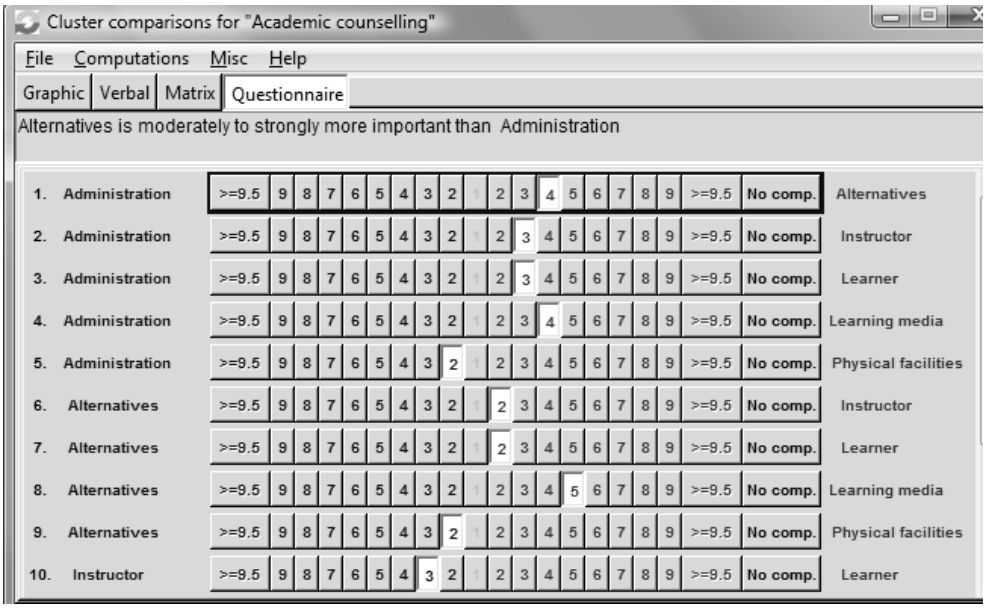

Figure 5. Pairwise comparisons of clusters

A benefit of the ANP model is that allows assessing the consistency of the judgments, which is not possible to evaluate with the method of assigning weights by consensus (Lesmes *et al*. 2009). The ANP employs redundant comparisons to ensure the validity of judgments and also provides a measure of inconsistency for discarding inconsistent judgments. According to the consistency calculations, all pairwise comparisons are consistent in this study.

4.3. Numerical Results

The priorities derived from the pairwise comparisons of the factors provide the essential inputs for the unweighted supermatrix while the priorities derived from the pairwise comparisons of the clusters are multiplied times the appropriate elements there to give the weighted supermatrix. The limit of the weighted matrix is calculated to net out the dominance for all the factors in the system. The limit matrix gives synthesized values that provide relative priorities of both the alternatives and the elements in the clusters (Sagir, Ozturk 2010). As mentioned before, the comparisons are done by a group of learners. Since the problem has different participants, the geometric mean is used to combine the many judgments into a single representative judgment for that comparison. The limit matrix gives synthesized values that provide relative priorities of both the alternatives and the elements in the clusters. Table 2 lists the alternatives and criteria with their relative weights from the limit matrix. The largest weight in each cluster is written in bold.

Table 2. Relative weights of the alternatives and criteria

Cluster	Element	Priority
Academic counselling	Face-to-face consulting	0.00063
	Interactive TV broadcasts	0.00002
	Internet based asynchronous consulting	**0.00065**
	Internet based synchronous consulting	0.00057
	Videoconference	0.00008
Alternatives	Associate	0.00408
	Bachelor's	**0.00785**
	Certificate	0.00118
	Doctorate	0.00771
	Master	0.00383
Learning media	face-to-face	0.00054
	printed materials	0.00020
	TV programs	0.00007
	Videoconference	0.00056
	virtual classes	0.00056
	web based courses	**0.00134**
Learner	academic background	0.00129
	age distribution	**0.01557**
	facility usage	0.00025
	Interaction	0.00104
	living area	0.00015
	working status	0.00050

Cluster	Element	Priority
Administration	number of learners	0.05785
	Prestige	**0.43666**
	student fee	0.02928
	Technology	0.00411
	Validity	0.41205
Evaluation	e-portfolio	0.00042
	online examination	0.00072
	paper based examination	0.00026
	Practicum	0.00118
	term projects	**0.00419**
Physical facilities	Campus	0.00000
	computer and technology centers	**0.00013**
	Laboratories	0.00003
	local centers	0.00010
	regional centers	0.00010
Instructor	instructional designing	0.00165
	know how	**0.00234**
	response time	0.00026

According to the weights, *Prestige* is determined as the most influential decision criteria in the open and distance learning system selection process. *Age distribution* is also determined as the most important criterion as the learner property. In the learning media side, web based courses are the most preferred media by the learners. The learners give a great importance to the term projects and also to the computer and technology centres.

The priorities of the alternatives are given in the second column of Table 3.

Table 3. Overall outcome

Alternatives	**Limiting**	**Normalized priority (normalized by cluster)**
Associate	0.00408	0.165
Bachelor's	**0.00785**	0.318
Certificate	0.00118	0.048
Doctorate	0.00771	0.313
Master	0.00383	0.156

According to the decision model, Bachelor's programs are selected as the most appropriate open and distance learning program based on the defined criteria.

5. CONCLUSIONS

The purpose of this research is to examine the behaviours of the learners involving in open and distance learning systems and to determine the important criteria affecting the systems in the meaning of selection of an open and distance learning program.

The ANP is the first mathematical theory that makes it possible for us to deal systematically with all kinds of dependence and feedback. It has been used in various decision problems like supplier selection to evaluation of alternative energy sources of a country. This study has identified and weighted open and distance learning systems' criteria and alternative program types. For this purpose a multi criteria methodology is applied from the perspective of open and distance learners. The learners select the Bachelor's program as the most appropriate open and distance learning program. All the defined criteria are significant but the learners also prioritize the criteria.

The major contribution of this study is to help learners to select an open and distance learning program. Though the judgments can vary from one learner to another, a general decision framework is constructed. We believe that, the criteria weights will also help administrators to investigate their systems and policy. In this respect, institutions can make decisions about their strategic planning like selecting which learning media to develop or to make an investment which academic counselling to support the learners.

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