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Research Article

A Performance Analysis for Face-to-Face, Distance and Hybrid Education Models Based on Student Satisfaction

Serap Tepe[1*]

[1*] University of Health Sciences, Faculty of Health Sciences, Department of Occupational Health and Safety, İstanbul, Turkey, (ORCID: 0000-0002-9723-6049), serap.tepe@sbu.edu.tr

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Abstract

Learning is to bring about permanent behavioral change in the individual. Different methods and models are used for the realization of learning. The face-to-face learning model, which has served education for many years, leaves its place to other models with the development of technology. However, some lack of enthusiasm and deficiencies experienced during this transition process affect the learner's decisions in terms of psychological, technical and educational competence. The situation is interesting when students are asked to make a choice between face-to-face education, distance education and hybrid education. The present paper focuses on the comparison of the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) and VlseKriterijumska Optimizcija I Kaompromisno Resenje (VIKOR) to resolve preferences in education methods in higher education system. The ranking of the different education methods can be similar to solving multiple criteria decision-making (MCDM) problems. In this paper, Analytical Hierarchy Process (AHP) -TOPSIS based approach was used. Then it was tested using the VIKOR method to validate the results obtained and the proposed model. The study was conducted with 4009 university students answering the survey questions. Despite technological opportunities and changes, face-to-face education model emerges as the most preferred model, it is followed by hybrid model and distance education model.

Keywords: Higher education, Distance education, Education models, MCDM, TOPSIS, VIKOR

Öğrenci Memnuniyetine Dayalı Yüz Yüze, Uzaktan ve Hibrit Eğitim Modelleri için Performans Analizi

Öz

Öğrenme, bireye kalıcı davranış değişikliği getirmektir. Öğrenmenin gerçekleşmesi için farklı yöntem ve modeller kullanılmaktadır. Uzun yıllar eğitime hizmet veren yüz yüze öğrenme modeli, teknolojinin gelişmesiyle birlikte yerini diğer modellere bırakıyor. Bununla birlikte, bu geçiş sürecinde yaşanan bazı eksiklikler, öğrencinin psikolojik, teknik ve eğitimsel yeterlilik açısından kararlarını etkilemektedir. Öğrencilerden yüz yüze eğitim, uzaktan eğitim ve karma eğitim arasında bir seçim yapmaları istendiğinde durum ilginçtir. Bu makale, yüksek öğretim sistemindeki eğitim yöntemlerinde tercihleri çözmek için Tercih Sıralaması Tekniğinin İdeal Çözüme Benzerlik (TOPSIS) ve VlseKriterijumska Optimizcija I Kaompromisno Resenje (VIKOR) ile karşılaştırılmasına odaklanmaktadır. Farklı eğitim yöntemlerinin sıralaması, bir çok kriterli karar verme (MCDM) problemidir. Bu yazıda Analitik Hiyerarşi Süreci (AHP) -TOPSIS tabanlı yaklaşım kullanılmıştır. Ardından, elde edilen sonuçları ve önerilen modeli doğrulamak için VIKOR yöntemi kullanılarak test edilmiştir. Araştırma, anket sorularını yanıtlayan 4009 üniversite öğrencisi ile gerçekleştirildi. Teknolojik fırsatlara ve değişikliklere rağmen en çok tercih edilen model olarak yüz yüze eğitim modeli ortaya çıkmakta, onu hibrit model ve uzaktan eğitim modeli takip etmektedir.

Anahtar kelimeler: Yüksek öğrenim, Uzaktan eğitim, Eğitim modelleri, ÇKKV, TOPSIS, VIKOR

[*] Corresponding Author: serap.tepe@sbu.edu.tr

1. Introduction

Humankind has faced many dramatic paradigms shifts throughout the history. There are different ways to adapt to those shifts. Three prominent strategies adopted by people and/or individuals are as follows: (I) Lead the change mandated by the paradigm shift and become a pioneer in the new era by setting the rules, (II) Follow the emerging patterns of changes immediately in order not to lag behind, (III) Let the change alter the individual. No matter which strategy is adopted, it is obvious that paradigm shifts and required/mandated changes take some time to settle down and then become permanent. However, the pandemic seems to have changed the basic criteria of change. With the effect of Covid 19, many changes in all areas of life were included in the game before they had the opportunity to fully mature. Perhaps, for the first time, the concept of 'learning by living' is seen simultaneously all over the world. In this process, which is called the new normal, change takes place in every field, from working life to shopping, from eating and drinking habits to holiday preferences, from the use of technology to education. In fact, pandemic is not a new concept; there are many epidemic diseases that have affected the world at different times. Many pandemics have taken place throughout human history, and they all had various effects and devastations. All of them had casualties and changing lifestyles. However, the situation in Covid 19 is different; It is the speed of spread of the effects of the pandemic with advanced technology. The point that distinguishes Covid 19 from others is that, this journey creates a butterfly effect. In our world, where change in one area triggers changes in another area, and the boundaries are more uncertain and accessibility increases due to the intensive use of technology, Covid19 will be more effective than other pandemics seen throughout human history. There is a struggle on many fronts to adapt to the new normal, to change and improve circumstances. Perhaps the most important one of these fronts is education. Education, which is also used in the sense of upbringing, is a life adventure that is carried out for the individual to stand on their own feet, to understand the age one is in and to try to bring the future closer. Learning is an effort to bring about desired directional and permanent behavioral changes in the individual. Throughout history, the concepts of education and learning have always kept people busy. Education, which was mostly face-to-face at all levels, was started to be distance education as the pandemic period necessity. Distance education is a system where the learner and teacher are not physically together. This separation has been defined in many sources as time and space. Face-to-face education is a system where the learner and the teacher can see each other, and this system is synchronous, generally known as a system that does not require much use of technology. In the case of the current pandemic, the transition to distance education is different for each country and sometimes for every educational institution within a country. While some institutions prefer broadcasting over television, some institutions reach students with various applications. In the use of these applications, there are variations such as making the courses synchronous or asynchronous as in formal education. The differences are not only in reaching the student, but also in the use of materials and assessment. In this paper, higher education students were asked to compare face to face education, distance education and the hybrid education in terms of technical characteristics, educational functioning characteristics and criteria for psychological evaluation. The aim of the present paper is to interpret the distance education experiences of students. It was aimed to determine whether face-to-face education, distance education or hybrid education types are preferred by the students. Thus reached 4009 higher education students who are in the pandemic process in Turkey, then they are asked to answer the questions about the learning satisfaction. The purpose of this study is to develop a comprehension for assessing the satisfaction of students about distance learning. It is inevitable that education models will change with the needs in our world where accessibility is increased due to the intensive use of technology. The pandemic crisis experience has accelerated this change. Throughout this process, distance education has become the lifeblood of education as a model that has more advantages than disadvantages. However, with the new normal, it will not be sufficient to use the distance education model to meet all needs of education in general. In the light of all this information, face to face education will remain up-to-date and vital until the inadequacies of distance education are fully eliminated. Many questions arise on the present subject. Will distance education replace face to face education? or should distance education be considered as an integral part of face to face education? Will the co-education model, which we come across as hybrid learning, also provide time and opportunity for educators to eliminate the shortcomings of distance education? Which education method will be more preferred by students? Specific objectives for the study are to determine the academician performance in distance education in terms of students, to establish the comprehension for assessing the satisfaction of students about distance learning and to determine the impact of using e-learning strategies on the efficiency of learning practices. The research questions were utilized to guide data collection while also structuring the research instruments used. This study has technical assessment questions such as the level of computer skills that affect online learning behaviors. It also tries to establish the level of social and demographic factors that affect the learning behaviors of students. Feeling comfortable in distance education and be able to communicate are seem to be important psychological factors. The efficiency of distance education and the preferences to continue in distance education even if the conditions return to normal are other research questions for the study. The process is a pandemic crisis and if this crisis can be managed well in terms of education, positive results can be achieved. The best way to see the shortcomings of distance education in practice is to measure student satisfaction. To the best of our knowledge, there is no such wide-ranging student satisfaction study of comparing distance education with face-to-face education in terms of technical characteristics, educational functioning characteristics and criteria for psychological evaluation. Recently, researchers have paid more attention to the distinction between the distance education and face to face education. Martinez et al. (2019) studied the transition process from face-to-face learning to distance learning in engineering master program. They determined the challenges as exams, assignments, and evaluations during this process. They suggested that hybrid and online education should be used together. Alenezi (2020) studied the effect of e-learning materials on the development of learning. This study suggested that the increase in e- material use positively influences learning behavior. Alghamdi et al (2020) studied academic performance in face-to-face and online classes in terms of self-efficacy and gender factors.

Carlson et al (2020) suggest that the use of portable learning technologies increases student participation and a sense of commitment in the learning process. Fish et al (2019) studied business students' perceptions on online versus face-to-face education in terms of the student characteristics. They made comparisons based on the criteria of being undergraduate or graduate, gender, previous experience and self-discipline. They recommended that students feel they are more motivated, disciplined, self-directed and independent in the face to face classroom setting. Evans et al (2019) tried to construct the professional development course, by allowing teachers to become online learners, and collaborating with teachers to plan and implement purposeful online activities in their subjects. Teachers were also required to evaluate the impact of their implementation on student learning. Fish et al (2019) studied how demographic factors, specifically the academic factors of an instructor, affect their perceptions. Analysis of the differences between online and face-to-face perspectives on many individual and program factors demonstrated significant differences. The intention here is to evaluate the specific academic factors of the instructor. Nunez et al (2016) studied the challenges in transformation from higher education to open education. Furthermore, Monk et al (2019) recommended blended learning, a combination of face-to-face and computer-assisted pedagogy. They suggested blended learning is gaining acceptance at universities as an alternative learning experience. Pala et al (2019) stated that distance education has become widespread in universities with the development of the internet in recent years. According to this study, in the field of distance education, it is necessary to measure the quality of the services provided by the institutions and to ensure the sustainability of the institutions. Tratnik et al (2019) studied student satisfaction with an online and a face-to face Business English course in a higher education context. The results indicate that there are significant differences in student satisfaction levels between online and face-to-face learning of English as a foreign language. Students taking the face-to-face course were generally more satisfied with the course on several dimensions than their online counterparts. Usher and Barak (2020) studied team diversity as a predictor of innovation in team projects of face to- face and online learners, in the study the differences observed between face-to-face and online learners are presented. Wang et al (2019) claimed that despite the explosive growth of online learning in higher education, it has also raised some pressing concerns regarding low student engagement and high dropout rates in online courses and programs. Yen et al (2018) conducted a three-way comparison of face-to-face, online, and blended teaching modalities to determine if there were differences in student academic outcomes and course satisfaction across modalities. Student academic outcomes were measured by two examinations; one research paper assignment, and the overall course total grade. Yıldız and Seferoğlu (2020) examined the self-efficacy perceptions of distance education students regarding online technologies in terms of various variables. In this study, it was found that the perceptions of self-efficacy towards online technologies by the students who undertake distance education are relatively high. Self-efficacy perception was researched based on gender and it has been concluded that males have higher self-efficacy perception than females. In the study, the self-efficacy perceptions were also handled based on the age range, and it was concluded that the self-efficacy belief is increased as the age range increased. This situation is interpreted as individuals' abilities may increase as their ages progress, therefore their self-efficacy may also increase. Gökmen et al. (2016) stated that the recent spread of mobile technologies in distance education has created the concept of new learning. The ability of these technologies to be portable and to connect to the internet has the feature of eliminating the time and place limitation in almost all aspects of distance education. Consequently, those who learn from the use of mobile technologies in distance education can easily and quickly obtain information wherever they want, in line with their needs. In their study, Nenning et al (2019) evaluated student attitudes and performance in an online and a face-to-face inorganic chemistry course. The study claimed that student-to-instructor interactions and student-to-student interaction promote critical thinking and force students to engage with the course material at higher levels of learning. Mendiluze et al (2020) suggested a learning-by-teaching methodology through games can be used to promote informatics (computer science) in education. They claimed applying the computer activities can change students' perception of informatics, the experience can also help students acquire competencies in teaching. Related literature shows that many factors are critical in differentiation of education styles. This paper reports student satisfaction in comparing distance education with face-to-face education in terms of technical characteristics, educational functioning characteristics and criteria for psychological evaluation. In the study, it was aimed to propose a road map for what the envisioned system would be in terms of education while habits and needs change. It was aimed to determine whether face-to-face education, distance education or hybrid education types are preferred by the students. This situation is a decision-making problem. To decide; it is defined as a selection process for determining the appropriate one among the alternatives. Both the abundance of alternatives in the decision process and the high number of criteria that affect the decision make the process complicated. Many studies in the literature used multi criteria decision making (MCDM) methods for performance measurement in different sectors. Bilişik et al (2013), suggested a hybrid fuzzy approach consisting SERVQUAL, the Delphi method, fuzzy analytic hierarchy process (AHP) and fuzzy technique for order preference by similarity to ideal solution (TOPSIS) methodologies for the evaluation of public transportation system. The SERVQUAL method is used for classifying the public transportation evaluation criteria, the Delphi method is used to obtain the evaluations of experts, fuzzy AHP is used to determine the weights of the criteria and fuzzy TOPSIS is applied to rank the alternatives. Kaya et al (2019) analyzed a large number of papers that use fuzzy MCDM methods to solve energy policy and decision-making problems with respect to some characteristics such as types of fuzzy sets, year, journal, fuzzy MCDM method, country and document type. The results of this study indicate that fuzzy AHP, as an individual tool or by integrating with another MCDM method, is the most applied MCDM method and type-1 fuzzy sets are the most preferred type of fuzzy sets. Eren et al (2019) aimed to determine the safety of hospitals in their medical waste management function. The study involved the determination of medical waste management steps, establishment of a hierarchical structure, and weighting of the criteria within the established hierarchical structure by means of the AHP method. Afterwards, the extent to which these criteria are adopted in hospitals was evaluated by the medical waste management officers of those hospitals, and safety scores were obtained for each hospital by associating

the results with the weighted values obtained by the AHP method. Korkusuz et al (2020) used AHP, PROMETHEE and GRA in their performance measurement method. First, safety indicators were identified and weighted by AHP. Then, data was collected, and performances of companies were measured by using GRA and PROMETHEE. This article is structured as follows. Section II presents the methodology of the research. Section III introduces the characteristics of the data collected during the process. The results obtained are discussed in Section IV. Finally, the conclusions and future research directions are outlined in Section V.

2. Material and Method

Higher Educational Institutions began providing most of their services online during the pandemic situation. This situation began in the middle of the spring semester, which was unforeseen for both instructors and students. The main framework of this study is to evaluate the performance of three different education styles from the students' perspectives. For data collection, 4009 higher education students who are located in Turkey during the pandemic process answered the questions about the evaluation of the three different education styles such as face to face, distance and hybrid models based on technical, psychological and educational factors. 20 questions were asked to students. 5 of these questions are about technical factors (questions 1,2,3,11,15); 7 of them are about educational factors (questions 4,5,8,9,14,18,20) and the others are about psychological factors (questions 6,7,10,12,13,16,17,19). There are several different reasons why technical parameters are measured in the study. Firstly, it is aimed to observe whether the students have the necessary infrastructure for distance education. In addition, it was also questioned whether the students could get help immediately when they encountered a problem in distance education. The reason is that the study is aimed to reveal how these factors affect the quality of distance education and the effect of technology-related factors on education. Education-related parameters were also aimed to be measured in the study. These parameters aimed to observe students' synchronous / asynchronous preferences for distance education. The students were asked to state their beliefs whether distance education met all their needs for professional equipment and also their thoughts whether there is time and space limitation in distance education is better or worse for the continuity of education were questioned. It is believed that some kind of skills like solving technical problems, discussing issues with other students easily, asking instant questions to the lecturer are connected to students' synchronous / asynchronous preferences for distance education. Even after the pandemic, preferences for going to school for face-to-face education over distance education, although the problems like traffic-weather conditions-time constraints-staying away from the family, etc. can be considered based on the education-related parameters. Psychological parameters, such as the student's participation in the lesson, beliefs about the fairness of the exams, the rate of being able to concentrate in the lesson, their ability to ask questions and how they feel in distance education were aimed to be measured in the study and the participants were asked questions about these issues. For the selection of alternatives, where there are multiple criteria, the best alternative is MCDM that enables selection called methods. First, to decide the problem to be solved and to realize the purpose must be determined. The present paper focuses on the comparison of the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) and VlseKriterijumska Optimizcija I Kaompromisno Resenje (VIKOR) to resolve preferences in education methods in higher education system. The ranking of the different education methods can be similar to solving multiple criteria decision-making (MCDM) problems. In this paper, Analytical Hierarchy Process (AHP) -TOPSIS based approach was used. Then it was tested using the VIKOR method to validate the results obtained and the proposed model. Also, questionnaire analysis was mainly used for Statistical Packaging Social Software (SPSS) and AHP method for weighting and ranking alternatives. The priority of each education method was calculated using the TOPSIS and these results are crosschecked with VIKOR method; thus, both methods were compared while overcoming uncertainty and achieving optimal results in the process.

2.1. AHP Method

AHP is a method that considers the relationship between criteria and alternatives and enables the analysis of components by creating a hierarchical structure. With this method, in decision problems where many criteria are considered, criterion weights can be calculated, and an appropriate decision alternative can be selected to determine the extent to which criteria should be considered in achieving the goal. In AHP technique, criteria and alternatives are subjected to binary comparisons by decision makers. The preference scale with 1-9 points developed by Saaty (1980) is used in the transactions. Binary comparisons of the criteria and alternatives are made. The importance weights of the criteria are determined. The pairwise comparison scale is given in Table 1.

Table 1. The pairwise comparison scale

Importance Values	Description
1	*The case that the two compared criteria are of equal importance*
3	*If the first criterion is more important than the second criterion*
5	*The first criterion is much more important than the second criterion*
7	*The first criterion has a very strong importance in the second criterion*
9	*The condition that the first criterion has an absolute priority over the second criterion*
2, 4, 6, 8	*Intermediate values that can be used in necessary situations*

Steps for AHP are given as follows (Tepe 2014).

Step 1: Defining the problem statement and determining the purpose in the problem.

Step 2: Starting from the purpose and main criteria, putting the middle level criteria and the lowest level alternatives in a hierarchical structure.

Step 3: Making binary comparisons between both alternatives and criteria and preparing paired comparison matrices in (n x n) dimension to determine which alternative or criterion is dominant.

Step 4: For each column in the binary comparison matrix, taking the column sums and normalizing the matrix by dividing the elements in the matrix by the corresponding column sum.

Step 5: Getting the total row totals for each alternative or criterion in the normalized matrix. (Priority vector matrix)

Step 6: Multiplying the priority values obtained for each criterion or option with all the elements in the column in the binary comparison matrix for that criterion or option. (weighted sum matrix)

Step 7: Dividing the row total values in the weighted aggregate matrix by the row values of the priority matrix and calculating the arithmetic average of the values in the final matrix of the (n x 1) dimension (the largest eigenvalue of the matrix.

Step 8: Calculating the consistency ratio

Step 9: Calculating the final priority value to be achieved by multiplying the criteria priorities obtained as a result of the comparisons for each alternative.

2.2. TOPSIS Method

The TOPSIS is one of the well-known multi-criteria decision-making methods. It is based on selection of alternatives that have the shortest distance from the positive-ideal solution and the farthest distance from the negative-ideal solution. Steps for TOPSIS are given as follows. (Aslantaş,2019)

Step 1: Construct the Pythagorean fuzzy decision matrix.

$$D = \begin{pmatrix} \alpha_{11} & \alpha_{12} & \cdots & \alpha_{1n} \\ \alpha_{21} & \alpha_{22} & \cdots & \alpha_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \alpha_{m1} & \alpha_{m2} & \cdots & \alpha_{mn} \end{pmatrix} \quad (1)$$

Step 2: Normalize.

$$r_{ij} = \begin{cases} \alpha_{ij} \; ; \; j \in B \\ \alpha_{ij}^{c} \; ; \; j \in C \end{cases} \quad (2)$$

Step 3: Construct the score matrix.

$$R = \begin{pmatrix} M_{(r_{11})} & M_{(r_{12})} & \cdots & M_{(r_{1n})} \\ M_{(r_{21})} & M_{(r_{22})} & \cdots & M_{(r_{2n})} \\ \vdots & \vdots & \ddots & \vdots \\ M_{(r_{m1})} & M_{(r_{m2})} & \cdots & M_{(r_{mn})} \end{pmatrix} \quad (3)$$

Step 4: Determine the distance separation of each alternative from the ideal and anti-ideal alternatives.

$$d(A_i, a^+) = \sqrt{\sum_{j=1}^{n} \left\{ \omega_j \left(M(a^+) - M(r_{ij}) \right)^2 \right\}^2} \quad (4)$$

and $d(A_i, a^-) = \sqrt{\sum_{j=1}^{n} \left\{ \omega_j \left(M(r_{ij}) - M(a^-) \right)^2 \right\}^2}$ (5)

Step 5: Compute the closeness coefficient (CC).

$$CC_i = \frac{d_i(A_i, a^-)}{d_i(A_i, a^+) + d_i(A_i, a^-)}, \quad i = 1,2, \ldots, m \quad (6)$$

Step 6: Rank the alternative.

2.3. VIKOR Method

The VIKOR method, characterized as an MCDM model, concentrates on the ranking and selection of a set of alternatives in the existence of multiple criteria.

Steps for VIKOR are given as follows. (Liu et al 2013)

Step 1: Establish the decision matrix.

$$X = \begin{bmatrix} I_{11} & I_{1j} & \cdots & I_{1n} \\ \cdots & \cdots & \cdots & \cdots \\ \cdots & \cdots & \cdots & \cdots \\ I_{m1} & I_{m2} & \cdots & I_{mn} \end{bmatrix} \quad (7)$$

Step 2: Determine the normalized decision matrix. f_{ij} is the value of ith criterion for the alternative.

$$f_{ij} = \frac{I_i^j}{\sqrt{\sum_{i=1}^{m} (I_i^j)^2}} \; i = 1, 2, \ldots m; \quad j = 1,2,\ldots n \quad (8)$$

Step 3: Calculate the Utility measure (S_i) and Regret measure (R_i). w_i is the weight of the ith criterion; $(f_{ij})_{max}$ and $(f_{ij})_{min}$ are the best and worst values, respectively, of all the criterion functions for all the alternatives.

$$S_i = \sum_{i=1}^{n} w_i \left[\frac{(f_{ij})_{max} - (f_{ij})}{(f_{ij})_{max} - (f_{ij})_{min}} \right] \text{ for beneficial criteria.} \quad (9)$$

$$S_i = \sum_{i=1}^{n} w_i \left[\frac{(f_{ij}) - (f_{ij})_{min}}{(f_{ij})_{max} - (f_{ij})_{min}} \right] \text{ for non-beneficial criteria.} \quad (10)$$

$$R_i = Maximum\ of \left\{ w_i \left[\frac{(f_{ij})_{max} - (f_{ij})}{(f_{ij})_{max} - (f_{ij})_{min}} \right] \right\} i = 1,2, \ldots n \quad (11)$$

for beneficial criteria.

$$R_i = Maximum\ of \left\{ w_i \left[\frac{(f_{ij}) - (f_{ij})_{min}}{(f_{ij})_{max} - (f_{ij})_{min}} \right] \right\} i = 1,2, \ldots n \quad (12)$$

for non-beneficial criteria.

Step 4: Calculate the value of Q_i, which represents the VIKOR index.

$$Q_i = v \left[\frac{S_i - (S_i)_{min}}{(S_i)_{max} - (S_i)_{min}} \right] + (1 - v) \left[\frac{R_i - (R_i)_{min}}{(R_i)_{max} - (R_i)_{min}} \right] \quad (13)$$

v is introduced as the weight of strategy of 'the majority of criteria' (or 'the maximum group utility'), here $v = 0{:}5$ (v can take any value from 0 to 1)

Step 5: Rank the order of preference by the Q_i value.

The framework of the proposed process is given in figure 1.

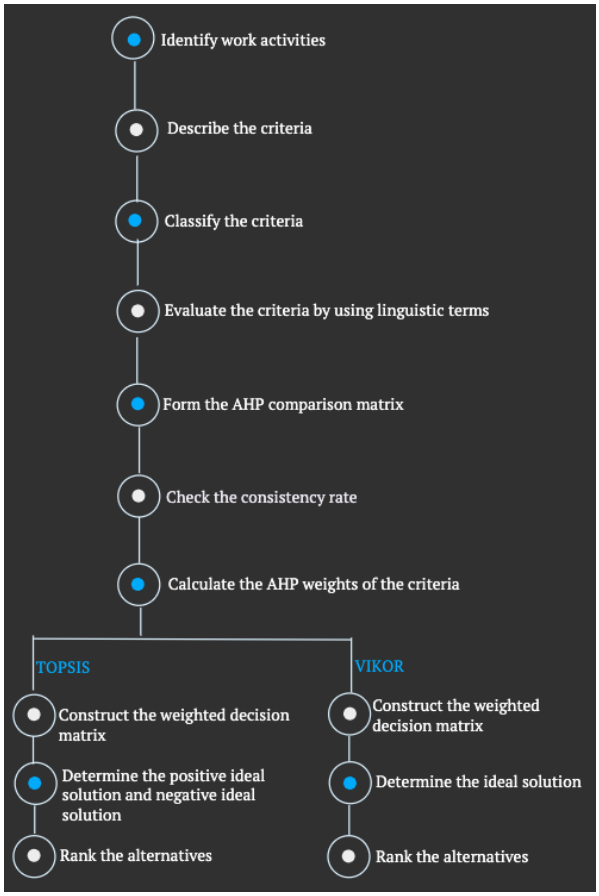

Figure 1. Framework of the proposed process.

3. Findings

3.1. Demographic Findings

Demographic findings of the study conducted are as follows; it belongs to gender, age, school type, education level, class information, the number of people receiving distance education at home and the types of devices used in distance education. Of the 4009 students participating in the study, 2980 are female and 1029 are male students. Male students constitute 25.7% of all students, while female students correspond to 74.3% of all students. The gender dispersion of the students who participated in the study is given in Table 2.

Table 2. The gender dispersion of the students

Gender	Number	Frequency
Female	2980	74.3
Male	1029	25.7
Total	4009	100

While 814 of the 4009 students participating in the study were studying at a state university, there were 3195 students studying at a foundation university. While the students studying at the state university constitute 20.3% of all participants, the participants studying at the foundation university correspond to 79.7% of all students. University types of students participating in the study is given in Table 3.

Table 3. University types of students

	Number	Frequency
State	814	20.3
Foundation	3195	79.7
Total	4009	100

Of the 4009 students who participated in the study, 2181 were studying at an associate degree vocational school, and 1828 at a faculty at the undergraduate level. Vocational school students constitute 54% of all students, while faculty students constitute 45.6% of the total participation. Education levels of the students participating in the study is given in Table 4.

Table 4. Education levels of the students

	Number	Frequency
Vocational school	2181	54.4
Faculty	1828	45.6
Total	4009	100

While 1542 of the 4009 students participating in the study attend distance education alone at home, it is seen that the remaining 2467 students have to share the facilities at home with their siblings. The number of people at home who receive distance education at the same time is given in Table 5.

Table 5. Number of siblings who receive distance education at the same time

Number of siblings	Number	Frequency
0	1542	38.5
1	1082	27.0
2	846	21.1
3	400	10.0
4	139	3.5
Total	4009	100

Of the 2181 vocational high school students participating in the study, 1077 students are in the first grade and 1089 are in the second grade. Of the 1828 faculty students participating in the study, 657 are in the first grade, 477 are in the second grade, 437 are in the third grade, and 257 are in the fourth grade. Class information of the students is given in Table 6.

Table 6. Class information of the students

	Class				
	1	**2**	**3**	**4**	**Total**
Vocational school	1077	1089	10	5	2181
Faculty	657	477	437	257	1828
Total	1734	1566	447	262	4009

Students participating in the research use their mobile phones at most with 52.1% while they follow the distance education. The types of devices used while following distance education lessons are given in Table 7.

Table 7. The types of devices used while following distance education

The types of devices	**Number**	**Frequency**	**Percentage of cases**
Computer	2411	45.3%	60.1%
Mobile phone	2774	52.1%	69.2%
Tablet	138	2.6%	3.4%
Total	5323	100%	132.8%

3.2. Research Findings

As a result of comparing the evaluation criteria among themselves, a strong relationship was observed between the training evaluation criteria and the technical evaluation criteria. These results indicate that the performance of distance education depends on the adequacy of the technical infrastructure. The comparison of evaluation criteria is given in Table 8.

Table 8. The comparison of evaluation criteria

		Psychology Evaluation Criteria	**Education Evaluation Criteria**	**Technical Evaluation Criteria**
Psychology Evaluation Criteria	*Correlation Coefficient*	1	0.297	0.290
	P Value		0.000	0.000
	Number	4009	4009	4009
Education Evaluation Criteria	*Correlation Coefficient*	0.297	1	0.649
	P Value	0.000		0.000
	Number	4009	4009	4009
Technical Evaluation Criteria	*Correlation Coefficient*	0.290	0.649	1
	P Value	0.000	0.000	
	Number	4009	4009	4009

Table 9. The device preferences

	(I) Device	(J) Device		Mean Difference (I-J)	Standard Error	P Value
Psychology	*Computer*		*Mobile phone*	0.722	0.150	0.000
			Tablet	-0.159	0.448	1.000
			Computer. Mobile phone	-0.007	0.150	1.000
			Computer. Tablet	-1.188	1.243	1.000
			Mobile phone. Tablet	-1.896	0.610	0.095
			All	-1.119	0.475	0.358
	Mobile phone		*Computer*	-0.722	0.150	0.000
			Tablet	-0.881	0.447	0.701
			Computer. Mobile phone	-0.730	0.145	0.000
			Computer. Tablet	-1.910	1.243	0.986
			Mobile phone. Tablet	-2.618	0.609	0.005
			All	-1.841	0.473	0.004
	Tablet		*Computer*	0.159	0.448	1.000
			Mobile phone	0.881	0.447	0.701
			Computer. Mobile phone	0.152	0.447	1.000
			Computer. Tablet	-1.029	1.312	1.000
			Mobile phone. Tablet	-1.737	0.741	0.394
			All	-0.960	0.635	0.951
	Computer. Mobile phone		*Computer*	0.007	0.150	1.000
			Mobile phone	0.730	0.145	0.000
			Tablet	-0.152	0.447	1.000
			Computer. Tablet	-1.180	1.243	1.000
			Mobile phone. Tablet	-1.888	0.609	0.097
			All	-1.112	0.473	0.365
	Computer Tablet		*Computer*	1.188	1.243	1.000
			Mobile phone	1.910	1.243	0.986
			Tablet	1.029	1.312	1.000

		Computer. Mobile phone	1.180	1.243	1.000
		Mobile phone. Tablet	-0.708	1.376	1.000
		All	0.068	1.322	1.000
	Mobile phone Tablet	*Computer*	1.896	0.610	0.095
		Mobile phone	2.618	0.609	0.005
		Tablet	1.737	0.741	0.394
		Computer, Mobile phone	1.888	0.609	0.097
		Computer, Tablet	0.708	1.376	1.000
		All	0.777	0.758	1.000
	All	*Computer*	1.119	0.475	0.358
		Mobile phone	1.841	0.473	0.004
		Tablet	0.960	0.635	0.951
		Computer. Mobile phone	1.112	0.473	0.365
		Computer. Tablet	-0.068	1.322	1.000
		Mobile phone. Tablet	-0.777	0.758	1.000
Education	*Computer*	*Mobile phone*	1.214	0.232	0.000
		Tablet	-0.460	0.978	1.000
		Computer. Mobile phone	-0.396	0.249	0.917
		Computer. Tablet	-0.603	2.750	1.000
		Mobile phone. Tablet	-0.436	1.149	1.000
		All	-2.356	0.810	0.094
	Mobile phone	*Computer*	-1.214	0.232	0.000
		Tablet	-1.674	0.973	0.875
		Computer. Mobile phone	-1.609	0.232	0.000
		Computer. Tablet	-1.817	2.749	1.000
		Mobile phone. Tablet	-1.650	1.145	0.976
		All	-3.570	0.805	0.001
	Tablet	*Computer*	0.460	0.978	1.000
		Mobile phone	1.674	0.973	0.875

		Computer. Mobile phone	0.065	0.977	1.000
		Computer. Tablet	-0.143	2.908	1.000
		Mobile phone. Tablet	0.024	1.488	1.000
		All	-1.896	1.245	0.948
	Computer Mobile phone	*Computer*	0.396	0.249	0.917
		Mobile phone	1.609	0.232	0.000
		Tablet	-0.065	0.977	1.000
		Computer. Tablet	-0.207	2.750	1.000
		Mobile phone. Tablet	-0.041	1.149	1.000
		All	-1.961	0.810	0.314
	Computer Tablet	*Computer*	0.603	2.750	1.000
		Mobile phone	1.817	2.749	1.000
		Tablet	0.143	2.908	1.000
		Computer. Mobile phone	0.207	2.750	1.000
		Mobile phone. Tablet	0.167	2.970	1.000
		All	-1.753	2.856	1.000
	Mobile phone Tablet	*Computer*	0.436	1.149	1.000
		Mobile phone	1.650	1.145	0.976
		Tablet	-0.024	1.488	1.000
		Computer. Mobile phone	0.041	1.149	1.000
		Computer. Tablet	-0.167	2.970	1.000
		All	-1.920	1.383	0.981
	All	*Computer*	2.356	0.810	0.094
		Mobile phone	3.570	0.805	0.001
		Tablet	1.896	1.245	0.948
		Computer. Mobile phone	1.961	0.810	0.314
		Computer. Tablet	1.753	2.856	1.000
		Mobile phone. Tablet	1.920	1.383	0.981
Technical	*Computer*	*Mobile phone*	1.739	0.183	0.000

	Tablet	-0.570	0.789	1.000
	Computer. Mobile phone	-0.400	0.192	0.554
	Computer. Tablet	-1.708	2.124	1.000
	Mobile phone. Tablet	-0.624	1.041	1.000
	All	-1.842	0.597	0.057
Mobile phone	*Computer*	-1.739	0.183	0.000
	Tablet	-2.309	0.787	0.115
	Computer. Mobile phone	-2.139	0.184	0.000
	Computer. Tablet	-3.447	2.124	0.977
	Mobile phone. Tablet	-2.363	1.039	0.499
	All	-3.581	0.595	0.000
Tablet	*Computer*	0.570	0.789	1.000
	Mobile phone	2.309	0.787	0.115
	Computer. Mobile phone	0.170	0.789	1.000
	Computer. Tablet	-1.138	2.258	1.000
	Mobile phone. Tablet	-0.055	1.292	1.000
	All	-1.273	0.971	0.989
Computer Mobile phone	*Computer*	0.400	0.192	0.554
	Mobile phone	2.139	0.184	0.000
	Tablet	-0.170	0.789	1.000
	Computer. Tablet	-1.308	2.124	1.000
	Mobile phone. Tablet	-0.225	1.041	1.000
	All	-1.443	0.598	0.318
Computer Tablet	*Computer*	1.708	2.124	1.000
	Mobile phone	3.447	2.124	0.977
	Tablet	1.138	2.258	1.000
	Computer. Mobile phone	1.308	2.124	1.000
	Mobile phone. Tablet	1.083	2.358	1.000
	All	-0.135	2.198	1.000

Mobile phone Tablet	*Computer*	0.624	1.041	1.000
	Mobile phone	2.363	1.039	0.499
	Tablet	0.055	1.292	1.000
	Computer. Mobile phone	0.225	1.041	1.000
	Computer.Tablet	-1.083	2.358	1.000
	All	-1.218	1.185	1.000
All	*Computer*	1.842	0.597	0.057
	Mobile phone	3.581	0.595	0.000
	Tablet	1.273	0.971	0.989
	Computer. Mobile phone	1.443	0.598	0.318
	Computer. Tablet	0.135	2.198	1.000
	Mobile phone. Tablet	1.218	1.185	1.000

During the pandemic, students attended classes with a computer, mobile phone or tablet in distance education. The effects of these device preferences on the evaluation criteria were compared and various findings were obtained. According to the study, a positive relationship was found between the use of computers in distance education and all three evaluation criteria. The device preferences are given in Table 9.

Table 10. The effect of gender on assessment criteria

Gender		Number	Mean	Standard Deviation	Standard Error Mean
Psychology	*Female*	2980	23.758	3.650	0.067
	Male	1029	23.033	4.164	0.130
Education	*Female*	2980	19.944	5.803	0.106
	Male	1029	20.529	6.652	0.207
Technical	*Female*	2980	15.989	4.669	0.086
	Male	1029	15.835	5.267	0.164

Table 11. The effect of students' education level on evaluation criteria

		Number	Mean	Standard Deviation	Standard Error Mean
Psychology	*Vocational School*	2181	23.235	4.029	0.086
	Faculty	1828	23.974	3.470	0.081
Education	*Vocational School*	2181	20.620	6.481	0.139
	Faculty	1828	19.466	5.394	0.126
Technical	*Vocational School*	2181	16.260	4.992	0.107
	Faculty	1828	15.580	4.602	0.108

"When the education levels of the students were examined, a significant relationship was found between education and technical evaluation criteria for vocational school students. The effect of students' education level on evaluation criteria is given in Table 11.

Table 12. The effect of university types on evaluation criteria

		Number	Mean	Standard Deviation	Standard Error Mean
Psychology	*State*	814	23.950	3.775	0.132
	Foundation	3195	23.476	3.803	0.067
Education	*State*	814	19.220	5.542	0.194
	Foundation	3195	20.316	6.137	0.109
Technical	*State*	814	15.168	4.778	0.167
	Foundation	3195	16.149	4.823	0.085

When the university students were examined, a meaningful relationship was found with the students studying at the foundation university in terms of education evaluation criteria. The results are given in Table 12.

Table 13. The relationship between distance education exams and injustice

		12- I think that exams without supervision in distance education cause injustice.	17- After the pandemic, I prefer the distance education processes to continue.
12- I think that exams without supervision in distance education cause injustice.	*Pearson Correlation*	1	-,305**
	P value		0,000
	Number	4009	4009
17- After the pandemic, I prefer the distance education processes to continue.	*Correlation coefficient*	-,305**	1
	Sig. (2-tailed)	0,000	
	Number	4009	4009

According to the results in Table 13, students think that uncontrolled and unattended exams in distance education are unfair. This thought affects students' willingness and motivation to continue distance education after the pandemic. For this reason, the scarcity of students who stated as 'I would prefer the distance education processes to continue after the pandemic' indicates that a new assessment and evaluation system will be needed.

Table 14. The relationship between lecturer performance in distance education and the desire to continue distance education

		18- I find the lecturer performance of the course better in distance education compared to face-to-face education.	20- Post-pandemic new normally Traffic-Weather conditions-Time Constraint-Staying away from the family, etc. Despite the circumstances, I prefer going to school for face-to-face education over distance education.
18- I find the lecturer performance of the course better in distance education compared to face-to-face education.	*Pearson Correlation*	1	-,364**
	Sig. (2-tailed)		0,000
	Number	4009	4009
20- Post-pandemic new normally Traffic-Weather conditions-Time Constraint-Staying away from the family, etc. Despite the circumstances, I prefer going to school for face-to-face education over distance education.	*Pearson Correlation*	-,364**	1
	Sig. (2-tailed)	0,000	
	Number	4009	4009

According to the Table 14, one of the factors that increases student motivation in distance education has been identified as the performance of the lecturer. Having the camera on during the lesson, use of different techniques by the lecturer and synchronizing the lesson seem to increase the distance education motivation of the student. From here, it is understood that just the delivery of an asynchronous audio file to students will result in failure for distance education. It is thought that the

lack of technical infrastructure of the lecturers, who have experienced distance education for the first time, and the difficulties they encounter in adapting the process psychologically is the cause of this situation.

Table 15. Relationship between meeting professional needs in distance education and preferring face to face education

		5- The courses I take through distance education meet all the needs for my professional equipment.	**20- Post-pandemic new normally Traffic-Weather conditions-Time Constraint-Staying away from the family, etc. Despite the circumstances, I prefer going to school for face-to-face education over distance education.**
5- The courses I take through distance education meet all the needs for my professional equipment.	*Pearson Correlation*	1	-.266**
	Sig. (2-tailed)		0.000
	Number	4009	4009
20- Post-pandemic new normally Traffic-Weather conditions-Time Constraint-Staying away from the family, etc. Despite the circumstances, I prefer going to school for face-to-face education over distance education.	*Pearson Correlation*	-.266**	1
	Sig. (2-tailed)	0.000	
	Number	4009	4009

According to the information from the students, although they stated that the courses taken through distance education meet their professional skills, their preference for face-to-face education shows that students actually lead to a hybrid understanding in education. It has been understood that distance education is a system that cannot replace face-to-face education in full terms. The hybrid education model will provide the opportunity to eliminate the shortcomings of distance education and to continue the psychological advantages of the face-to-face education model. The results are given in Table 15.

Table 16. The relationship between synchronous lesson tracking and distance education satisfaction

		1- In the distance education system, I follow the lessons completely synchronous.	**8- It is better for the continuity of education to not have time and space limitations in distance education.**
1- In the distance education system, I follow the lessons completely synchronous.	*Pearson Correlation*	1	,058**
	Sig. (2-tailed)		0,005
	Number	2411	2411
8- It is better for the continuity of education to not have time and space limitations in distance education.	*Pearson Correlation*	,058**	1
	Sig. (2-tailed)	0,005	
	Number	2411	2411

The coexistence of the lecturer and the learner as in the master-apprentice relationship or at least sharing the same platforms simultaneously are among the factors that increase learning. For this reason, as seen in the results in Table 16, following the lessons live is an expected result to increase satisfaction in distance education.

Table 17. The desire to continue face to face education in the new normal

	Gender	**Number**	**Mean**	**Standard Deviation**	**Standard Error Mean**
	Female	2980	3.268	1.685	0.031
	Male	1029	3.055	1.731	0.054
Post-pandemic new normally Traffic-Weather conditions-Time Constraint-Staying away from the family, etc. Despite the circumstances, I prefer going to school for face-to-face education over distance education.	**University Type**	**Number**	**Mean**	**Standard Deviation**	**Standard Error Mean**
	State	814	3.452	1.661	0.058
	Foundation	3195	3.153	1.704	0.030
	Education Level	**Number**	**Mean**	**Standard Deviation**	**Standard Error Mean**
	Vocational School	2181	3.044	1.743	0.037
	Faculty	1828	3.416	1.623	0.038

Looking at the demographic information of the participants, who were asked about their preference for continuing face to face education, it has been observed that being female, being a student at a state university and being 4-year course undergraduates are more willing to continue face to face education. Throughout the study, education models, which were examined under three headings, as face-to-face, distance, and hybrid, were evaluated both in terms of student satisfaction, and it was aimed to find the ideal solution by considering it as a decision-making problem with the opinions of expert educators. In the study, first, the performance measurement methods and indicators were examined. The criteria indicators to be used in the study were determined by interviewing expert educators working in the field of education. Course follow up (synchronous / asynchronous), technical assistance, anxiety level, communication problems, exam issues, assessment and evaluation, concentration and performance of teaching staff are found as the criteria for the study. After a long preparation, the survey questions were created, and the validity and reliability of the questionnaire were tested in the front group. As the selection of indicators quantitatively (numerically) will make the results more objective, attention has been paid to the indicators being quantitative and thus measurable. The performance indicators using AHP method with the help of education experts are weighted. After data is collected, performance indexes of training models were obtained using TOPSIS and VIKOR methods. The results obtained by two different methods were compared with each other and the consistency of the study was examined. The structure of the proposed model is given in Figure 2.

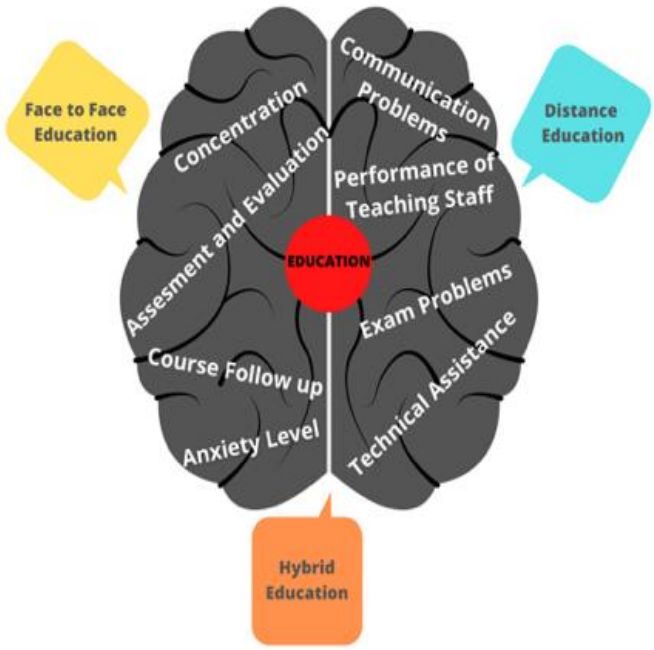

Figure 2. The structure of the proposed model

According to AHP results, assessment and evaluation, exam problems and concentration were determined as the most important criteria. No matter which educational model is used, one of the main points of understanding the permanence of education is assessment and evaluation. Exam problems that arise while making assessment and evaluation are another difficult situation for students. Another important parameter is the concentration and motivation required for learning to take place. The results are given in Table 18.

Table 18. Criteria according to AHP

Criteria	Weight
Course Follow up (synchronous / asynchronous)	0.0330
Technical Assistance	0.0716
Anxiety Level	0.0447
Communication Problems	0.0533
Exam Problems	0.2207
Assessment and Evaluation	0.3128
Concentration	0.1550
Performance of Teaching Staff	0.1090

Changes in people, environment and time require updates in education models. Distance education and hybrid education models, which are offered as an alternative to face-to-face education, have brought some disadvantages along with innovations. There are several actions that must be taken to turn these disadvantages into advantages. The inadequacies in assessment and evaluation system and the problems faced by students in exams can be counted among the disadvantages of the distance education model. In addition, the loss of concentration experienced in following lessons in distance education causes students to worry about this model. Distance education has been used at all educational levels throughout the pandemic process. In the present paper, the situation for higher education students was evaluated and it was understood that using the distance education model would not be sufficient to meet all the needs of education. For this reason, distance education should be considered as an integral element of face to face education rather than a replacement for it. The mixed education model, known as hybrid learning, will also provide the opportunity to overcome the shortcomings of distance education.

Table 19. Results according to TOPSIS

Si*	Si^-	Ci*	Rank
0.045	0.074	0.624	1
0.074	0.045	0.376	3
0.043	0.043	0.500	2

When the results are examined according to TOPSIS method for Performance Analysis for Face-to-Face, Distance and Hybrid Education Models Based on Student Satisfaction, the face-to-face education model has been identified as the most preferred model by students. Results are given according to TOPSIS method in Table 19.

Table 20. Results according to VIKOR

Si	Ri	Qi	Rank
1.00	0.31	0.50	1
0.00	0.00	-0.50	3
0.50	0.16	0.00	2

Rankings according to VIKOR method were found to be face-to-face education, hybrid education and distance education. Results are given according to VIKOR method in Table 20.

Table 21. Comparison of results according to TOPSIS and VIKOR

	TOPSIS	VIKOR
1	*Face to Face*	*Face to Face*
2	*Hybrid*	*Hybrid*
3	*Distance*	*Distance*

Comparison of results according to TOPSIS and VIKOR is given in Table 21. Rankings according to both methods were found to be face-to-face education, hybrid education and distance education. Considering the complex nature of learning, it is possible to find the results in this way. Because learning is not just receiving written information; it is also socializing, practicing, getting to know oneself and exchanging ideas. For this reason, it has been observed that higher education students do not prefer distance education despite their other advantages when they do not have the opportunity to practice their profession, when they lack opportunities for socialization, when they have technical infrastructure problems and when they lose their belief that assessment and evaluation are fair.

4.Discussion and Conclusion

Internet and computer-based distance education, which is defined as a great revolution in education, is becoming widespread day by day and the number of users is increasing. This educational model, which can be used a computer and internet is present, has changed the classical learning approach by bringing the educational service to the student's feet. In the lessons given by distance education method, students' knowledge level about internet and technical base of computer affects their approach to the lesson and their overall success. Online exams preferred in the distance education process have various benefits for both students and educators. The benefits of online exams on the internet are cost and time savings, storage of answers, convenient and fast feedback, flexibility and rapid results. Internet access and computer needs are the most important problems in online exams. Also, it is not secure, students are likely to cheat or it is hard to control whether the student has taken the exam himself. One of the factors affecting the success of distance education is the definition of the roles / competencies that instructors should have in online education settings and preparations to facilitate this process. The interaction between the learner and the teacher is an important factor for permanent learning. For this reason, following the lessons live in distance education increases student motivation, strengthens communication, and gives the student the feeling of sharing the same environment. This situation increases the efficiency of distance education. The distance education model requires being technology-friendly and solving a technical problem in the most effective way possible. For this reason, for the distance education model to be successful, both students and educators need to learn the technical infrastructure and determine their needs and provide them. In cases where this is not provided, the training model will be perceived as insufficient. Every new situation brings with its uncertainties. These uncertainties may reflect on students as anxiety. Having communication problems with the instructor, not being able to reach the instructor or school staff when there is a problem, and not getting answers to questions increase the level of anxiety. Increasing anxiety level affects educational performance. For all these reasons, distance education may not be where it deserves in terms of student satisfaction. In this case, hybrid learning emerges as an alternative model. Hybrid education, which is at a point between distance education and face-to-face education, carries traces of both models. In the paper, preference of these models was listed by comparing all three education models. The fact that the obtained results are also the same in the results of the student satisfaction questionnaire reveals the consistency and importance of the subject. Accordingly, students love innovations, but still prefer face-to-face education due to various factors. According to the results of MCDM, face-to-face education is still superior to other models. Looking at the results of many studies, it is seen that the vast majority of faculty still believe that distance learning is less qualified than face to face learning (Jaschik & Letterman, 2014). Findings from studies conducted to date show that there is no difference between face-to-face teaching and distance learning, but hybrid learning is more advantageous than online teaching in terms of learning performance (Means et al., 2009). Research into learning is not an easy task, due to the wide variety of variables and conditions that affect learning. Although there are technological developments and opportunities, why face-to-face education is still the first choice is an issue that should be considered. In distance education, only imitating face-to-face education, not using new teaching styles, or students' technical deficiencies may be the answer to this situation. In the present paper the performance indicators using AHP method with the help of education experts are weighted. After data is collected, performance indexes of training models were obtained using TOPSIS and VIKOR methods. The results obtained by two different methods were compared with each other and the consistency of the study was examined. At the same time, the questions based on the determined criteria were answered by 4009 higher education students and the results obtained were compared with the results of the MCDM. This paper examines the factors that affect the preference of educational models by students and highlights the reasons for the most preferred model. For future research, training models can be compared according to new developments that will emerge and what can be done for improvement can be discussed. The methodology recommended in the present paper can be utilized in performance evaluations of other processes. In future studies, VIKOR-TOPSIS can be compared with other multi-criteria decision-making extensions, such as intuitionistic fuzzy or hesitant fuzzy sets. In addition, the methodology suggested can be used in evaluation processes for different problems and its robustness can also be tested for different decision-making problems.

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