A Comparative Criteria Analysis via Fuzzy AHP Approach For The High School Students' Reasons For Selecting Higher Education Institutions

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ABSTRACT

The high school students choose the higher education institute to continue among different choices. In this study, it was examined whether there are differences among the higher education selection preferences for students at different high school levels. Depending on the literature review, the most important factors affecting the higher education selection were collected under 3 main criteria. These main criteria are "University Selection", "Profession Choice and "Socio-demographic Features". Under these 3 main criteria, 33 sub-criteria were considered in total. As a result of the surveys conducted for students of different grades, 5 most selected sub-criteria were determined for each main criterion. Fuzzy Analytical Hierarchy Process (F-AHP) was used to calculate the sub-criteria weights for each grade level. In the application part, two different analyzes were compared. Firstly, the preference criteria weights of Prep class and 12th class students of high school were compared. Secondly, the preference criteria weights of 9th class students who were Prep students previous year were compared according to this year's and last year's results. As a result of this study, changes of students' evaluations about higher education were observed year to year. In addition, consistency analysis was applied for F-AHP method which was used to determine the main and sub-criteria weights, and only the consistent questionnaires were used in the process.

Keywords: Higher Education Selection Criteria, Multiple Criteria Decision Making Methods, Fuzzy Analytical Hierarchy Process (F-AHP), Consistency

Farklı Sınıf Düzeyindeki Lise Öğrencileri Arasında Bulanık AHP Yöntemi Uygulanarak Üniversite Seçim Kriterlerinin Karşılaştırmalı Analizi

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ÖZET

Lise öğrencileri devam edecekleri yükseköğrenim kurumunu birçok farklı seçenek arasından seçerler. Bu çalışmada, farklı lise düzeyindeki öğrenciler arasında yükseköğrenim tercihleri göz önüne alındığında farklılaşmanın olup olmadığı incelenmiştir. Yapılan literatür araştırmasına dayanarak, yükseköğrenim seçimini etkileyen en önemli faktörler 3 ana başlık altında toplanmıştır. Bu ana kriterler "Üniversite Seçimi", "Meslek Seçimi" ve "Sosyo-Demografik Özellikler"dir. Bu 3 ana kriter altında toplamda 33 alt kriter ele alınmıştır. Farklı sınıf seviyelerindeki öğrencilere yapılan anketler sonucunda, her bir ana kriter için en çok seçilen 5er tane alt kriter belirlenmiştir. Her bir sınıf seviyesi için ayrı ayrı belirlenen alt kriterlerin ağırlıklarının hesaplanmasında Bulanık Analitik Hiyerarşi Prosesi (BAHP) kullanılmıştır. Uygulama kısmında yapılan iki farklı analiz karşılaştırılmıştır. Öncelikle lise hazırlık sınıfı öğrencileri ile lise son sınıf öğrencilerinin tercih kriter ağırlıkları karşılaştırılmıştır. İkinci olarak, geçtiğimiz sene lise hazırlık olan öğrencilerin geçen seneki ve bu seneki tercih kriter ağırlıkları karşılaştırılmıştır. Çalışmanın sonucunda, öğrencilerin yükseköğrenim hakkındaki değerlendirmelerinin seneden seneye değiştiği gözlemlenmiştir. Ayrıca ana ve alt kriter ağırlıkları belirlenirken kullanılan BAHP yöntemi için tutarlılık analizi uygulanmış ve süreçte sadece tutarlı anketler kullanılmıştır.

Anahtar Kelimeler: Yükseköğrenim Seçim Kriterleri, Çok Kriterli Karar Verme Teknikleri, Bulanık Analitik Hiyerarşi Prosesi (BAHP), Tutarlılık Analizi

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Extended Abstract

Choice of a higher education program is an important decision making problem for high school students. They consider many different criteria while choosing a higher education program. This study specifies 33 different criteria researched in many studies. These criteria are structured in a hierarchical way under three main criteria. These main criteria are "University Selection", "Profession Choice" and "Socio-demographic Features" and they are comprised of 12, 12, and 9 sub criteria, respectively.

On the other side, in order to find the relative importance weights of these criteria, a high school in Turkey is selected for application. This high school consists of four grades: preparatory (to be called as Prep from now on), 9th, 10th, 11th, and 12th grades. To compare the weights of criteria determined by different grade of high school students, a questionnaire is prepared and applied to Prep and 12th grade students. Based on the results of these questionnaires, five most selected criteria under each main criterion are determined for both Prep and 12th grade students. Then a second questionnaire is applied to Prep and 12th grade students. According to pair wise comparisons they perform, weights of main and sub-criteria are calculated by using Fuzzy Analytical Hierarchy Process (F-AHP), which is one of the most commonly used multi criteria decision making (MCDM) method. In order to check the validity of the students' preferences, consistency analysis is also applied. All of the calculations are performed by using the questionnaires. Depending on the results of criteria weights, we concluded that, 12th grade students emphasize more on "Profession Choice" main criterion. However, Prep grade students give more importance to "University Selection" main criterion. Also, the weights of sub criteria also differ between these two groups. Additionally, we check the consistency ratios of the questionnaires and find out that, 12th grade students' questionnaires are less consistent than Prep grade students.

Moreover, another comparison is performed to check whether the education period has an effect on the students' preferences. To do so, the same questionnaires are given to the same Prep grade students when they become 9th grade, after a one-year of education. By doing

this, we noticed that although the same students perform the same questionnaires, when a year has passed, their preferences have changed. When they become 9th grade, they defined the "Profession Choice" as the most important main criterion. It is interesting that, 9th grade students determine similar criteria weights to the 12th grade students' criteria weights. Also, the consistency analysis is also performed to the same Prep students when they become 9th grade. As it is expected, the rate of consistent questionnaires has increased. This is probably because of the fact that, they do the questionnaires as the second time.

The main contributions of this study to the literature are in three folds. Firstly, it elaborates many different higher education selection criteria and lists them in a hierarchical structure under three main criteria. Secondly, the preferences of different grade high school students are gathered. According to their preferences, relative weights of different criteria are calculated for different students group. These results are compared in two ways. Initially, Prep students' criteria weights are compared with 12th grade students' criteria weights. Then, the preferences of the same Prep students are compared with their preferences when they become 9th grade. The third contribution of this study is to check the validity of the questionnaires by consistency analysis.

The mapping of this study is as follows: In the introduction section, the main aim of the study and the motivations that trigger this study are explained. In the literature review, the studies analyzing the related criteria for higher education selection are examined. Also, Fuzzy Analytical Hierarchy Process (F-AHP), which is one of the most commonly used multi criteria decision making (MCDM) methods, is investigated. The steps of F-AHP are explained in detail because we use it while determining the relative importance weights of the criteria. In the proposed approach section, the hierarchical structure of the main and sub criteria are revealed. That section includes two sub-sections. In the first sub-section, the relative weights of the criteria determined by the Prep grade students are compared with the ones determined by 12th grade students. In the

second sub-section, when a year has passed and Prep students become 9th grade, we examine whether there are any changes between their current and previous preferences by applying same criteria. In the conclusion section, discussions about the results and further steps of this research are enlightened.

Introduction

In modern societies, self-actualization is one of the most valuable things for a person. It is the realization of full potential of oneself (D'Souza, 2018). One of the main standards to be a self-actualized person is selecting a job to earn money and future (Yılmaz et al., 2012). The initial step of deciding an occupation and following a fruitful vocation depends on the appropriate higher education decision. However, higher education decision is not straight forward and it depends on many factors like; high school education, personal characteristics, parents' requests, and surrounding environment. Therefore, a person should be aware of these factors and his/her competencies to give the best decision about his or her future.

As stated by Gati and Saka (2001), most people decide their occupation while they are attending high school education. So, students should be engaged to choose the right occupation by providing them the right counseling while high school education is continuing. To determine the profession, it is required to decide related higher education program. Because, the students decide not only the higher education program but also the profession that they will work with in rest of their lives (Kılıç and Ayhan, 2011). If higher education program is not selected consciously, graduated students cannot find a suitable job coherent with their personality. Despite of students' skills and their own interests in the process of career choice, social pressure can also be decisive. Because achieving the goals determined by their surroundings can be more influential than their capabilities regarding the profession selection. Even if the students are mindful of their own capabilities and concerns, they can choose an unsuitable career for themselves just because it has high status and is accredited in society. This can lead to misery in the future stages of the individual's life and decreases

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the work efficiency. So guiding to choose the right profession is a crucial role for high school students.

Since higher education selection is critical for profession selection, this article investigates the criteria related with higher education selection. Three main criteria; "University Selection", "Profession Selection" and "Socio-Demographic Features" and 33 sub criteria are examined for selection of higher education program. This study aims to find the relative importance weights of these criteria considered by the high school students. However, since the human beings are dynamic entities, the students' preferences can change in time while they are in different grades of high school. For the example case studied in this paper, high school education consists of 4 grades: preparatory (to be called as Prep from now on), 9th, 10th, 11th, and 12th grades. Therefore, the main aim of this study is to compare these weights between different grades of high school. This comparison is performed in two ways.

Firstly; we analyze the differences between Prep and 12th grade high school students' preferences. We expect the following results;

➢ Prep-grade students' evaluations are expected to be different from the 12th grade students'
➢ Prep-grade students' surveys are expected to be less consistent than 12th grade students'.

Secondly, we examine the changes in their preferences by applying same criteria to the Prep students in the following year when they become9thgrade. We want to observe the changes that occur after a one-year high school education. We expect the following results;

➢ Previous year's and this year's results about higher education selection criteria are expected to be different. This is probably because of the fact that students become more aware about criteria after a one-year high school education.
➢ The responses to the surveys are expected to be more consistent than previous year's results.

The mapping of this study is as follows: In the next section, literature is reviewed in two parts. In the first part, the studies analyzing the related criteria for higher education selection are examined. In the second part, Fuzzy Analytical Hierarchy Process (F-AHP), which is one of the most commonly used multi criteria decision making (MCDM) methods, is investigated. The steps of F-AHP are explained in detail because we use it while determining the relative importance weights of the criteria. In further section, the proposed approach is presented revealing the hierarchical structure of the main and sub criteria. That section includes two parts. In the first part, the relative weights of the criteria determined by the Prep grade students are compared with the ones determined by 12th grade students. In the second part, when a year has passed and Prep students become 9th grade, we examine whether there are any changes between their current and previous preferences by applying same criteria. In the last section, conclusions and further steps of this research are enlightened.

Literature Review

Firstly higher education selection criteria are investigated. Secondly, F-AHP, which is one of the MCDM methods, is reviewed. It is also explained in detail in order to use it while calculating the relative weights of the criteria.

Higher Education Selection Criteria

While the students are selecting the higher education, in fact they consider the profession they want to have in their future. Therefore, career choice is analyzed in many studies. It is related with criteria like university education (Çelik and Üzmez, 2014), personality characteristics of the student (Yanıkkerem, 2004), social environment (Kılıç and Ayhan, 2011), and being interested in occupation area (Sarıkaya and Khorshid, 2009).

Parson (1909) initialized the research about career choice. He mentioned that choosing an occupation is an important problem for people. According to Parsons (1909), this problem can be solved by being attentive to each person's capability, motivation and restraints.

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To achieve the success in the job, the abilities should be conformed to the requirements of the profession. Parsons (1909) also said, "No step in life, unless it may be the choice of a husband or wife, is more important than the choice of a vocation."

Göksu and Güngör (2008) studied about university preference ranking. They determined three main criteria which are "City", "University" and "Department of University" as a result of the questionnaires applied to high school students. Then they determined sub criteria for each of the three main criteria. Sub criteria for "City" are Dormitory Opportunities, Social Life, Costliness of City, Distance to Hometown and Scholarship. Sub criteria for "University" are, Education in University, Age of University and Social Opportunities. Sub criteria for "Department of University" are Being Interested in Department, Business Opportunities, Financial Gain and Popularity of Department. They calculated the weights of main criteria and sub-criteria by F-AHP. However, they did not consider the consistency analysis. Also, they did not compare the different grades of high school students while determining the criteria weights.

When students decide the university; they choose not only the higher education program but also the profession in which they will work in the rest of their lives. Kılıç and Ayhan (2011) grouped the important factors in deciding the university in two main criteria classes: "University Selection Criteria" and "City Selection Criteria". They calculated the relative weights of main and sub-criteria. As a result of this process, academic staff, foreign language, foreign connection, scholarship, popularity and entrance scores criteria were found important for "University Selection Criteria". Cultural and social aspects of city, cost of living conditions, distance to family and climate conditions criteria were considered important for "City of University".

Ayhan and Atsay (2011) stated that, deciding the university for a student who graduates from high school is not easy. There are many alternatives and all of them have different opportunities. If an

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unsuitable university is chosen, probably s/he will regret it throughout her/his life. In order to contribute to such a critical decision process, they determined university preference criteria as; university, department, scores taken from the higher education entrance exam and city. They also analyzed how much the high school students were conscious and consistent about their decisions (Ayhan and Atsay, 2011).

Tanhan and Yılmaz (2017) determined three main criteria as; economy, status and vocational/mental. The sub criteria for "economy" were money, good life, power and having everything one needs. The sub criteria for "status" were profession, eminence and a good job. The sub criteria for "vocational/mental" were happiness and success.

Due to the literature review, there are numerous different criteria for higher education selection. Also, the subject is researched from different point of views. Some researches examine the criteria for career choice. Some of them investigate the university preferences. Some others address the profession selection. However, the higher education selection isa comprehensive research area including all aspects of these selection processes.

Fuzzy Analytic Hierarchy Process (F-AHP)

Although there are various MCDM techniques in literature, Fuzzy Analytic Hierarchy Process (F-AHP) is used depending on its usability in vague decision cases. It is applied to determine the importance weights of higher education selection criteria. Before explaining F-AHP method, the information about fuzzy numbers and fuzzy sets should be given. Lotfi Zadeh (Zadeh, 1965) was the first to publish the information about fuzzy logic. In his article "fuzzy sets" and "fuzzy logic principles" were proposed to explain uncertainty. Fuzzy logic basically uses vagueness that exists both in human thought and in nature, such as approximation and ambiguity. Instead of "strictly correct" or "definite false" patterns; linguistic quantifiers are used like "better", "worse" or "many", "much" (Saaty and Tran, 2007).

On the other side, Analytic Hierarchy Process (AHP) uses precise numerical values and it cannot reflect the way of human thinking exactly. Because of the fuzzy nature of the benchmarking process, decision makers prefer to express binary comparisons instead of setting it as a constant value. F-AHP method embraces fuzzy set theory and hierarchical structure analysis for weighting of an alternative and selecting the best one. Fuzzy sets elements have degrees of membership. For each element, the membership degrees can vary from 0 to 1. These membership grades are continuous for a fuzzy set (Terceno et al., 2003).

In the literature, numerous papers use Fuzzy AHP to solve various decision making problems. Although there are different techniques developed in Fuzzy AHP, this study implements the Buckley's method (Buckley, 1985) to determine the relative importance weights of the criteria. The steps of the procedure are as follows (Ayhan, 2013;Ayhan and Kılıç, 2015):

Step 1: Decision Maker compares the criteria via linguistic terms shown in Table 1.

Table 1: Linguistic terms and the corresponding triangular fuzzy numbers (Paksoy et al., 2012)

Saaty Scale	Definition	Fuzzy Triangular Scale
1	Equally important (Eq. Imp.)	(1, 1, 1)
3	Weakly important (W. Imp.)	(2, 3, 4)
5	Fairly important (F. Imp.)	(4, 5, 6)
7	Strongly important (S. Imp.)	(6, 7, 8)
9	Absolutely important (A. Imp.)	(9, 9, 9)
2		(1, 2, 3)
4	The intermittent values between	(3, 4, 5)
6	two adjacent scales	(5, 6, 7)
8		(7, 8, 9)

According to the corresponding triangular fuzzy numbers of these linguistic terms, for example if the decision maker states "Criterion 1 (C1) is Weakly Important than Criterion 2 (C2)", then it takes the fuzzy triangular scale as (2, 3, 4). On the contrary, in the pair wise

contribution matrix of the criteria, comparison of C2 to C1 will take the fuzzy triangular scale as (1/4, 1/3, 1/2).

The pair wise contribution matrix is shown in Eq.1, where $\widetilde{d_{ij}^k}$ indicates the kth decision maker's preference of ith criterion over j^{th} criterion, via fuzzy triangular numbers. Here, "tilde" represents the triangular number demonstration and for the example case, $\widetilde{d_{12}^1}$ represents the first decision maker's preference of first criterion over second criterion, and equals to, $\widetilde{d_{12}^1} = (2, 3, 4)$.

$$A^k == \begin{bmatrix} \widetilde{d_{11}^k} & \cdots & \widetilde{d_{1n}^k} \\ \vdots & \ddots & \vdots \\ \widetilde{d_{m1}^k} & \cdots & \widetilde{d_{mn}^k} \end{bmatrix} \qquad (1)$$

Step 2: If there is more than one decision maker, preferences of each decision maker $(\widetilde{d_{ij}^k})$ are averaged and $(\widetilde{d_{ij}})$ is calculated as in the Eq. 2.

$$\widetilde{d_{ij}} = \frac{\sum_{k=1}^K \widetilde{d_{ij}^k}}{K} \qquad (2)$$

Step 3: According to averaged preferences, pair wise contribution matrix is updated as shown in Eq. 3.

$$\tilde{A} = \begin{bmatrix} \widetilde{d_{11}} & \cdots & \widetilde{d_{1n}} \\ \vdots & \ddots & \vdots \\ \widetilde{d_{m1}} & \cdots & \widetilde{d_{mn}} \end{bmatrix} \qquad (3)$$

Step 4: According to Buckley (1985), the geometric mean of fuzzy comparison values of each criterion is calculated as shown in Eq. 4. Here, $\widetilde{r_i}$ still represents triangular values.

$$\widetilde{r_i} = \left(\prod_{j=1}^n \widetilde{d_{ij}} \right)^{1/n} \qquad i=1, 2,...,n \qquad (4)$$

Step 5: The fuzzy weights of each criterion can be found with Eq. 5, by incorporating next 3 sub steps.

Step 5a: Find the vector summation of each $\widetilde{r}_i$.

Step 5b: Find the (-1) power of summation vector. Replace the fuzzy triangular number, to make it in an increasing order.

Step 5c: To find the fuzzy weight of criterion i ($\widetilde{w}_i$), multiply each $\widetilde{r}_i$ with this reciprocal vector.

$$\widetilde{w}_i = \widetilde{r}_i \otimes \left(\widetilde{r}_1 \oplus \widetilde{r}_2 \oplus \cdots \oplus \widetilde{r}_n \right)^{-1}$$
$$= \left(lw_i, mw_i, uw_i \right) \tag{5}$$

Step 6: Since $\widetilde{w}_i$ are still fuzzy triangular numbers, they need to de-fuzzified by Centre of area method proposed by Chou and Chang (2008), via applying Eq. 6.

$$M_i = \frac{lw_i + mw_i + uw_i}{3} \tag{6}$$

Step 7: M_i is a non fuzzy number. But it needs to be normalized by following Eq. 7.

$$N_i = \frac{M_i}{\sum_{i=1}^{n} M_i} \tag{7}$$

These 7 steps are performed to find the normalized weights of criteria.

The Proposed Approach

In order to compare the differences between the weights of higher education selection criteria among different grades of high school students, first of all 3 main and 33 sub criteria were determined depending on the literature reviews. As shown in Figure 1, the first main criterion is "University Selection". It includes; 'University's

name/Popularity', 'Scholarship opportunities', 'State/Private University', 'Education Language', 'Taking courses from different departments', 'Quota in the university department', 'Technological facilities', 'Cultural activities', 'Connection with foreign universities', 'Academic staff', 'Ranking scores of university entrance exams', and 'Social life in university'. The second main criterion is "<u>Profession Choice</u>". It comprises of following sub-criteria; 'Predisposition to the profession', 'Employment', 'Guidance of people', 'Social perception', 'Career opportunities', 'Self-perception', 'Salary', 'Working hours in a week', 'Supply-demand balance', 'Attitude of the family', 'Years spend for education'. The third main criterion is "<u>Socio-Demographic Features</u>". The related sub-criteria are; 'Dormitory opportunities', 'Distance to family', 'City of the university', 'Pre-university education', 'Parent's educational status', 'City's Climate conditions', 'Minimum living standards', 'Graduated high school', 'Student's social life'. The details of these criteria are discussed in detail in the literature (Akkaş, 2018; Akkaş and Ayhan, 2018).
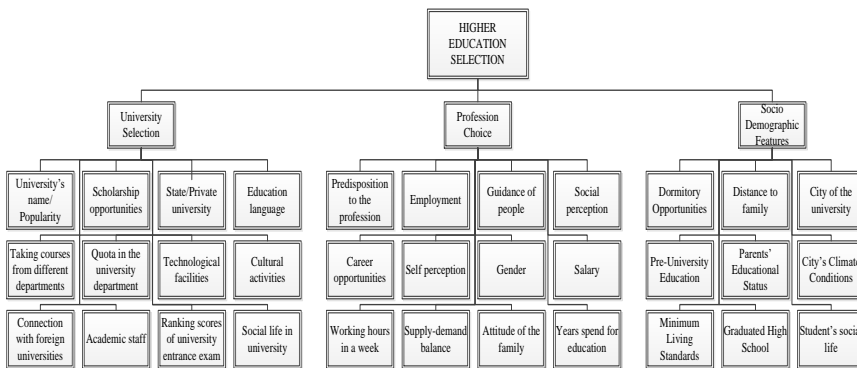
Figure 1: Hierarchical Representation of the Higher Education Selection Criteria

Secondly, we selected a high school in Istanbul in order to compare these 3 main criteria and 33 sub criteria according to their higher education preferences decided by different grade high school students. There are 5 different grades of students in this school; Prep grade, 9th grade, 10th grade, 11th grade and 12th grade. In the next sub-section, we examined the preference criteria of Prep and 12th

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grade students comparatively. In further sub-section we analyzed if there is any difference in the preference criteria of the students, who were Prep grade in previous year and now 9th grade.

Comparison Between Prep and 12th Grade Students

In this first section, we selected Prep and 12th grade students in order to compare the criteria weights.

Step 1: We prepared a questionnaire in order to identify most important sub-criteria among 33 mentioned above. The students were asked to score every sub criteria between 1 and 100. Then arithmetic mean was calculated for each sub criterion for both Prep and 12th grade students, separately. 186 out of 204 questionnaires were eligible to assess for Prep grade students. 154 out of 170 questionnaires were suitable to evaluate for 12th grade students. In order to determine criteria weights using Fuzzy AHP both for Prep and 12th grade students, we took 5 sub-criteria which have the highest averaged scores in every main criterion. We listed them for each main criterion in decreasing order and showed in Table 2 for Prep and 12th grade students (Akkaş, 2018). Hereby, C_1 represents the first main criterion, 'University Selection'. $C_{1,10}$ represents the 10th sub-criterion of 1st main criterion, 'Academic Staff'. It took the highest average score from both Prep students and 12th grade students. However, as it is seen, the ranking of the sub-criteria for each main criterion differs between Prep and 12th grade students.

Table 2: Ranking of the 5 sub criteria which have the highest average scores for Prep and 12th grade students, separately (Akkaş, 2018).

Main Criteria	Rank	Prep Grade Students		12th Grade Students	
		Sub criteria	Scores	Sub Criteria	Scores
University Selection (C_1)	1	Academic Staff ($C_{1,10}$)	89.414	Academic Staff ($C_{1,10}$)	91.305
	2	Ranking Scores of Unv. Entrance Exams ($C_{1,11}$)	87.144	Ranking Scores of Unv. Entrance Exams ($C_{1,11}$)	84.797

	3	Technological Facilities $(C_{1,7})$	85.348	Unv.'s Name/Popularity $(C_{1,1})$	81.672
	4	Cultural Activities $(C_{1,8})$	83.519	Social Life in University $(C_{1,12})$	79.984
	5	Connection with Foreign Unv. $(C_{1,9})$	82.613	Technological Facilities $(C_{1,7})$	77.859
Profession Choice (C_2)	1	Predisp. to the Profession $(C_{2,1})$	93.039	Predisp. to the Profession $(C_{2,1})$	92.055
	2	Career Opportunities $(C_{2,5})$	78.746	Working Hours in a Week $(C_{2,9})$	75.375
	3	Salary $(C_{2,8})$	78.685	Employment $(C_{2,2})$	75.109
	4	Working Hrs. in a Week $(C_{2,9})$	78.337	Career Opportunities $(C_{2,5})$	72.422
	5	Employment $(C_{2,2})$	75.840	Salary $(C_{1,10})$	70.758
Socio Demographic Features (C_3)	1	Student's Social Life $(C_{3,9})$	81.796	City of the University $(C_{3,3})$	83.531
	2	City of the University $(C_{3,3})$	81.475	Dormitory Opportunities $(C_{3,1})$	72.188
	3	Dormitory Opportunities $(C_{3,1})$	81.155	Pre-University Education $(C_{3,4})$	71.219
	4	Graduated High School $(C_{3,8})$	75.088	Student's Social Life $(C_{3,9})$	71.094
	5	Pre-University Education $(C_{3,4})$	74.818	Graduated High School $(C_{3,8})$	58.867

Step 2: Questionnaires were prepared to determine the weights of these 3 main and 15 sub-criteria to be applied to Prep and 12th grade students, separately. Here, the questionnaire for Prep students was different from the one for 12th grade students. Because, each group has a different set of 15-sub-criteria.

Step 3: The weights of main criteria were calculated for each individual Prep and 12th grade students by using F-AHP depending

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on the questionnaires. However, following calculations were explained just for an individual Prep student. According to the questionnaire, pair wise comparisons of main criteria for the selected Prep student were given in Table 3.

Table 3: Pair wise comparisons of main criteria for the selectedPrep student

#	A. Imp. (9, 9, 9)	S. Imp. (6, 7, 8)	F. Imp. (4, 5, 6)	W. Imp. (2, 3, 4)	Criterion	Eq. Imp. (1, 1, 1)	Criterion	W. Imp. (2, 3, 4)	F. Imp. (4, 5, 6)	S. Imp. (6, 7, 8)	A. Imp. (9, 9, 9)
1					University Selection		Profession Choice	✓			
2				✓	University Selection		Socio-Demog. Features				
3		✓			Profession Choice		Socio-Demog. Features				

Here, the selected Prep student decided that 'Profession Choice' main criterion is weakly more important than 'University Selection' main criterion. Comparison matrix with the values of the main criteria, which was acquired from the questionnaire, was displayed on Table 4.

Table 4: Comparison matrix according to the main criteria for the selected Prep student

Main Criteria	University Selection	Profession Choice	Socio Demographic Features
University Selection	(1, 1, 1)	(1/4, 1/3 ,1/2)	(4, 5, 6)
Profession Choice	(2,3,4)	(1, 1, 1)	(6, 7, 8)
Socio Demographic Features	(1/6, 1/5, 1/4)	(1/8, 1/7 ,1/6)	(1, 1, 1)

The geometric mean of fuzzy comparison values of each criterion were calculated by Eq. 4 and given in Table 5. For example, $\tilde{r}_1$-

geometric mean of fuzzy comparison values of 'University Selection' criterion is calculated as Eq. 8.

$$\tilde{r_1} = \left(\prod_{j=1}^{n} \widetilde{d_{1j}}\right)^{1/n} = \left[(1 * 1/4 * 4)^{\frac{1}{3}} ; (1 * 1/3 * 5)^{\frac{1}{3}}; \left(1 * 1/2 * 6\right)^{\frac{1}{3}}\right] = [1.000; 1.186; 1.442] \qquad (8)$$

Table 5: Geometric means of fuzzy comparison values for the selectedPrep student

CRITERIA	$\tilde{r_i}$		
University Selection	1.000	1.186	1.442
Profession Choice	2.289	2.759	3.175
Socio Demographic Features	0.275	0.306	0.347
Total	3.565	4.250	4.964
Reverse (power of -1) of Total Values	0.281	0.235	0.201
Increasing Order	0.201	0.235	0.281

The fuzzy weight of each criterion were found by the help of Eq. 5 and given in Table 6. For example, fuzzy weight of 'University Selection' main criterion is calculated as Eq. 9.

$$\widetilde{w_1} = [(1.000 * 0.201); (1.186 * 0.235); (1.442 * 0.281)] = [0.201; 0.279; 0.405] \qquad (9)$$

Table 6: Fuzzy weights of each main criterion for the selected Prep student

MAIN CRITERIA	$\widetilde{w_i}$		
University Selection	0.201	0.279	0.405
Profession Choice	0.461	0.649	0.891
Socio Demographic Features	0.055	0.072	0.097

The non-fuzzy weights of each criterion (M_i) were calculated by taking the average of fuzzy numbers for each criterion (via Eq. 6). Non-fuzzy M_i's, were normalized by Eq. 7 and the weights of main criteria (N_i) were computed and given in Table 7.

Table 7: Averaged and normalized relative weights of main criteria for the selected Prep student

CRITERIA	M_i	N_i
University Selection	0.295	**0.285**

Profession Choice	0.667	**0.643**
Socio Demographic Features	0.075	**0.072**

Step 4: We applied the same methodology to calculate the weights of sub criteria. At first, we analyzed the sub criteria under 'University Selection' main criterion by pair wise comparisons. Then the same steps were performed for the sub-criteria under the other two main criteria; 'Profession Choice' and 'Socio Demographic Features'. As a result, the relative and global non-fuzzy weights of each sub criterion under each main criterion were calculated and presented in Table 8.

Table 8: Relative and global weights of each sub criteria under each main criterion for the selected Prep student (Akkaş, 2018).

Main Criteria	Relative Weights Using Fuzzy AHP	Sub criteria	Relative Weights Using Fuzzy AHP	Global Weights Using Fuzzy AHP
University Selection	0.285	Academic Staff	0.040	0.011
		Ranking Scores of University Entrance Exams	0.035	0.010
		Technological Facilities	0.182	0.052
		Cultural Activities	0.143	0.041
		Connection with Foreign Universities	0.600	0.171
Profession Choice	0.643	Predisposition to the Profession	0.633	0.407
		Career Opportunities	0.111	0.071
		Salary	0.092	0.059
		Working Hours in a Week	0.074	0.048
		Employment	0.090	0.058
Socio-demog. Features	0.072	Student's Social Life	0.297	0.021
		City of the University	0.107	0.008

Dormitory Opportunities	0.389	0.028	
Graduated High School	0.175	0.013	
Pre-University Education	0.032	0.002	

Table 8 shows the results of the pair wise comparison based on the questionnaire of the selected Prep student via Fuzzy AHP. The same calculation steps were repeated for every student whose questionnaire was consistent. To specify the consistent questionnaires, consistency analysis was applied to each questionnaire

Step 5: Although there are few studies about consistency analysis for F-AHP, none of them is commonly agreed and widely accepted to be implemented for all F-AHP cases. Furthermore, the most accepted method for the consistency analysis is to transform fuzzy numbers to crisp versions and to proceed as in the consistency analysis of the crisp AHP (Başaran, 2012). Therefore, fuzzy weights of criteria were de-fuzzified to crisp weights and the steps explained in the literature were applied for the consistency analysis (Al-Harbi, 2001).To provide the fluency of the manuscript, the readers are referred to the literature for more detail (Al-Harbi, 2001; Mu and Pereyra-Rojas, 2017). The result of the consistency analysis performed for the selected Prep student was given in Table 9. All of the consistency ratios for pairwise comparisons of Main Criteria and 3 Sub-Criteria were less than 10%, which is the threshold to be consistent defined by Saaty (1980). Hence, the preferences of the selected Prep student were determined as consistent.

Table 9: Consistency analysis for the selected Prep student

Consistency Analysis	Pair-wise comparisons of *"Main Criteria"*	Pair-wise comparisons of sub criteria in *"University Selection"*	Pair-wise comparisons of sub criteria in *"Profession Choice"*	Pair-wise comparisons of sub criteria in *"Socio Demographic Features"*
λ_{max}	3.083	5.424	5.442	5.330

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Consistency Index	0.041	0.106	0.111	0.082
Randomnes s Index	0.580	1.120	1.120	1.120
Consistenc y Ratio	**0.071**	**0.095**	**0.099**	**0.074**

In order to determine the criteria weights of all Prep students, the previous steps were performed for each individual student. As stated before, 204 Prep students performed the questionnaires. However, 186 were suitable. Within the suitable ones, only 19 of the questionnaires were consistent for main criteria and three sub criteria pair-wise comparisons. Based on these consistent questionnaires, after applying F-AHP, we calculated relative weights of main criteria and the global weights of each sub-criterion for every Prep student. Average weights of main criteria were calculated and presented in the second column of the Table 10. Average global weights of each sub-criterion were calculated and presented in the fourth column of the Table 10 for Prep grade students.

Similarly, to determine the criteria weights of all 12th grade students, same steps were performed. As stated before, 154 out of 170 questionnaires were suitable for the analysis. However, just 12 of them were found to be consistent. Based on these consistent questionnaires, after applying F-AHP, relative weights of main criteria and the global weights of each sub-criterion were calculated for every 12th grade students. Average weights of main criteria were calculated and presented in the fifth column of the Table 10. Average global weights of each sub-criterion were calculated and presented in the seventh column of the Table 10.

Table 10: Comparison of average weights and global weights of Prep grade and 12th grade (Akkaş, 2018).

Prep Grade			12th Grade			
Main Criteria	Average Weights	Sub Criteria	Average Global Weights	Average Weights	Sub Criteria	Average Global Weights
University Selection	0.417	Academic Staff	0.105	0.256	Academic Staff Ranking Scores of University Entrance Exams	0.069
		Ranking Scores of University Entrance Exams	0.064		University's Name/Popularity	0.041
		Technological Facilities	0.051		Social Life in University	0.047
		Cultural Activities	0.057		Technological Facilities	0.048
		Connection with Foreign Universities	0.140			0.051
Profession Choice	0.393	Predisposition to the Profession	0.114	0.537	Predisposition to the Profession	0.156
		Career Opportunities	0.079		Working Hours in a Week	0.108
		Salary	0.072		Employment	0.083

		Working Hours in a Week	0.055		Career Opportunities	0.092
		Employment	0.073		Salary	0.098
Socio-Demographic features	0.190	Student's Social Life	0,042		City of the University	0.060
		City of the University	0.050		Dormitory Opportunities	0.032
		Dormitory Opportunities	0.035	0.207	Pre-University Education	0.029
		Graduated High School	0.049		Student's Social Life	0.058
		Pre-University Education	0.014		Graduated High School	0.029

As seen in Table 10, weights of main criteria are not same for Prep and 12th grade students. For Prep grade students, weights of university selection criterion, profession choice criterion, and socio demographic features criterion are, 41.7%, 39.3%, and 19%, respectively. On the other side, for 12th grade students, they have the weights of 25.6%, 53.7% and 20.7%, respectively. The weights of main criteria are not too close to each other for different two grades. One of the reasons for this, it can take a long time to change ideas. Therefore Prep students will be 12th grade after four years. These four years are enough to have fundamental changes of ideas. Students are also at the age of their adolescence at high school and their ideas can change rapidly. Another reason of having different weights for the main criteria can be influencing by each other's ideas during decision making process, because all students are in the same school.

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If we examine the weights of main criteria for 12th grade students particularly, "*Profession Choice*" is noticed as to have the most importance weight. Second and third important criteria are "*University Selection*" and "*Socio-Demographic Features*". On the other side for Prep students, the most important criteria are; "*University Selection*", "*Profession Choice*", and "*Socio-Demographic Features*". These results are not in the same rank in both groups. Prep grade students think they can progress in career after deciding university according to socio demographic characteristics. They want to enter a good university firstly. Because university is the first step and focus point of career aim after graduating high school. So, they give more importance to university selection. However, 12th grade students pay attention to profession choice firstly. They think there are many universities with the same department and it does not matter which university they graduate from. So they focus predominantly the profession that they choose.

Comparison Between Prep and 9th Grade Students

In the second part of the comparative criteria analysis, the preferences of the students which were Prep students last year were compared with the preferences of the students which are now 9th grade. Since we had the preferences of the last year's Prep students in previous section, previously mentioned 5 steps have been performed for the 9th grade students this year. The ranking of sub-criteria which had the 5 highest average scores by 9th grade students, were found and shown in Table 11. Their average scores were also compared with the ones of last year's Prep students.

Table 11: Ranking of Sub Criteria for Last Year's Prep and This Year's 9thGrade Students Separately (Akkaş, 2018).

Main Criteria	Rank	Last Year's Prep Grade Students		This Year's 9th Grade Students	
		Sub criteria	Scores	Sub Criteria	Scores
UNIVERSITY SELECTION (...)	1	Academic Staff ($C_{1,10}$)	89.414	Ranking Scores of Unv. Entrance Exams ($C_{1,11}$)	86.581

	2	Ranking Scores of Unv. Entrance Exams ($C_{1,11}$)	87.144	Academic Staff ($C_{1,10}$)	84.946
	3	Technological Facilities ($C_{1,7}$)	85.348	Social Life in University ($C_{1,12}$)	81.338
	4	Cultural Activities ($C_{1,8}$)	83.519	Connection with Foreign Unv. ($C_{1,9}$)	78.628
	5	Connection with Foreign Unv. ($C_{1,9}$)	82.613	Technological Facilities ($C_{1,7}$)	78.432
PROFESSION CHOICE (C_2)	1	Predisp. to the Profession ($C_{2,1}$)	93.039	Predisp. to the Profession ($C_{2,1}$)	91.040
	2	Career Opportunities ($C_{2,5}$)	78.746	Employment ($C_{2,2}$)	78.608
	3	Salary ($C_{2,8}$)	78.685	Career Opportunities ($C_{2,5}$)	77.635
	4	Working Hours in a Week ($C_{2,9}$)	78.337	Salary ($C_{1,10}$)	77.426
	5	Employment ($C_{2,2}$)	75.840	Working Hours in a Week ($C_{2,9}$)	74.054
SOCIO DEMOGRAPHIC FEATURES (C_3)	1	Student's Social Life ($C_{3,9}$)	81.796	Student's Social Life ($C_{3,9}$)	80.095
	2	City of the University ($C_{3,3}$)	81.475	City of the University ($C_{3,3}$)	76.953
	3	Dormitory Opportunities ($C_{3,1}$)	81.155	Pre-University Education ($C_{3,4}$)	76.473
	4	Graduated High School ($C_{3,8}$)	75.088	Dormitory Opportunities ($C_{3,1}$)	75.392
	5	Pre-University Education ($C_{3,4}$)	74.818	Graduated High School ($C_{3,8}$)	73.027

To determine the criteria weights of this year's 9th grade students, pair-wise comparison questionnaires were performed. 150 out of 165 questionnaires are suitable for the analysis. However, just 25 of them are found to be consistent. Based on these consistent questionnaires, after applying F-AHP, we calculated relative weights of main criteria and the global weights of each sub-criterion for each 9th grade students. Average weights of main criteria were

calculated and presented in the fifth column of Table 12. Average global weights of each sub-criterion were calculated and presented in the seventh column of Table 12.

Table 12: Comparison of average weights and global weights of Prep grade and 9th grade (Akkaş, 2018).

| Main Criteria | Last Year's Prep Grade Students | | | This Year's 9th Grade Students | | Grade |
	Average Weights	Sub Criteria	Average Global Weights	Average Weights	Sub Criteria	Average Global Weights
University Selection	0.417	Academic Staff ($C_{1,10}$)	0.105	0.248	Ranking Scores of University Entrance Exams	0.040
		Ranking Scores of University Entrance Exams	0.064		Academic Staff	0.063
		Technological Facilities	0.051		Social Life in University	0.037
		Cultural Activities	0.057		Connection with Foreign Universities	0.062
		Connection with Foreign Universities	0.140		Technological Facilities	0.045
Profession Choice	0.393	Predisposition to the Profession	0.114	0.543	Predisposition to the Profession	0.130
		Career Opportunities	0.079		Employment	0.064
		Salary	0.072		Career Opportunities	0.103

Socio Demographic features					
		Working Hours in a Week	0.055	Salary	0.144
		Employment	0.073	Working Hours in a Week	0.102
	0.190	Student's Social Life	0.042	0.209	Student's Social Life	0.045
		City of the University	0.050		City of the University	0.043
		Dormitory Opportunities	0.035		Pre-University Education	0.037
		Graduated High School	0.049		Dormitory Opportunities	0.043
		Pre-University Education	0.014		Graduated High School	0.041

As seen in Table 12, weights of main criteria are not same for Prep and 9th grade students. However, they are almost the same students with one year difference. For last year's Prep grade students, "University Selection" criterion's weight is 41.7%, profession choice criterion's weight is 39.3% and socio demographic features have a weight of 19.0%. On the other side for this year's 9th grade students, "University Selection" criterion's weight is 24.7%, profession choice has a weight of 54.3% and finally socio demographic features criterion has 20.9%. The weights of main criteria are not too close to each other for these two groups. The students changed their minds after a one-year high school education. It is also noticed that, 9th grade students' results are close to 12th grade students' results. The weights of criteria are close to each other for these two grades. Also, the criteria are ranked in the same order. Since all students are in the same school, they can influence each other's ideas during decision making process.

As a summary, Table 13lists just the weights of main criteria for Prep, 9th and 12th grade students while considering the higher education criteria. As it is seen; the main criteria weights of 9th and

12th grade students are close to each other. Besides this, the main criteria weights of the Prep students are different from the criteria weights of 12th grade students. Furthermore, the preferences of Prep students are also different from the 9th grade students. It is likely that a one-year high school education makes a difference in the value judgments of students.

Table 13: Summary of main criteria weights for Prep, 9th and 12th grade students(Akkaş, 2018).

Main Criteria	Prep Grade	9th Grade	12th Grade
University Selection	0.417	0.248	0.256
Profession Choice	0.393	0.543	0.537
Socio-Demographic Features	0.190	0.209	0.207

In addition, when the consistencies of the pair-wise comparison matrices are investigated, following information is gathered for the questionnaires performed. As it is seen in Table 14, for Prep grade students, 186 of 204 questionnaires were suitable for calculation. However, just 19 of them were found to be consistent. For 9th grade students, 150 of 165 questionnaires were suitable and 25 of them were found to be consistent. For 12th grade students, 154 of 170 questionnaires are suitable and 12 of them were consistent. As we expect, the rate of consistent questionnaires increase when last year's Prep students perform the same questionnaire when they become 9th grade. However, it is interesting that, the rate of consistent questionnaire for 12th grade students is 7.79% which is less than the one for last year's Prep students.

Table 14: Information about the questionnaires

Info. About The Questionnaires	Prep Grade	9th Grade	12th Grade
# of Questionnaires	204	165	170
Suitable Questionnaires	186	150	154
Consistent Questionnaires	19	25	12
Rate of Consistent Questionnaires	10.21%	16.67%	7.79%

Conclusion

In order to perform a comparative criteria analysis for the higher education selection between different grades of high school students,

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3 main and 33 sub criteria were determined through the literature reviews. Then a high school with 5 different grades (Prep, 9th, 10th, 11th, and 12th grades) was selected. The most important 5 sub criteria for 3 main criteria were determined by Prep and 12th grade students. The importance weights of these criteria were calculated by F-AHP and compared for both Prep and 12th grade students. In addition, after a year passed, when Prep students became 9th grade, it was checked whether there is a difference between their preferences. Hence the importance weights of the criteria were calculated again for 9th grade students and compared with previous year's Prep students' preferences.

First anticipated result about Prep's and 12th grade students is that the evaluation by different grade students is different for all the criteria. Secondly, the responses by Prep grade students are expected to be less consistent than the responses by 12th grade students. After applying the process, it is realized that weights of main and sub criteria are found different for different grade students. Hence, the first anticipated result is achieved. However, Prep grade's questionnaires become more consistent according to 12th grades' questionnaires. This is just the opposite of second anticipated result. In addition, it is realized that Prep grade students think about university at first position. Then they think profession and socio demographic features criteria. But 12th grade students consider that career is more important than university. Since same department exists in many universities, they think that they can choose universities which provide the same profession.

For the second part of the analysis, the 9th grade students' results are expected to be different from the results of previous year's Prep grade students' results. When the results are analyzed, this anticipated result is achieved. The other expectation about second part is to achieve more consistent results for 9th grade students than previous year's Prep grade students' results. If questionnaires are examined, it is also realized that 9th grade students' results are more consistent as it is expected. Awareness about criteria can be interpreted as increasing for 9th grade students. Although they are

almost same students, Prep grade students' results are different from 9th grade students' results. When Prep grade students passes to 9th grade, they have similar preferences as 12th grade students. However, the 9th grade students' opinions are different from their opinions while they were Prep students.

As further research area, the same study can be applied to students who were in the Prep grade previous year when they passes to12[th] grade after 3 years. The change in their preferences about higher education can be analyzed. In addition, since we have only analyzed the changes in the criteria weights comparatively in this study, a study which examines different alternatives comparatively can be done for a specific student throughout 4 years. It is possible to observe how the students' preferencechange over years as an individual and as a group. Moreover, the weights of main and sub-criteria can be decided by embedding hesitancy in decision making (Ayhan, 2018). In addition, these results can be used as a tool in the future to guide students towards the right profession. On the other side, by analyzing the criteria weights and average scores, the universities in Turkey can be aware of which criteria are important for high school students. Hence, they can re-organize themselves and try to attract the students' attention according to these criteria.

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