*Journal of Infrastructure, Policy and Development* 2024, 8(2), 2168.
https://doi.org/10.24294/jipd.v8i2.2168

Article

# Analysis of settlement parameters of architecture faculties on university campus

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**CITATION**

Doraj P, Özyılmaz H, Akar U. (2024). Analysis of settlement parameters of architecture faculties on university campus. Journal of Infrastructure, Policy and Development. 8(2): 2168. https://doi.org/10.24294/jipd.v8i2.2168

**ARTICLE INFO**

Received: 28 May 2023
Accepted: 21 September 2023
Available online: 29 December 2023



**Abstract:** The selection of a suitable place for an activity is an important decision made for a project, which requires assessing it from different points of view. Educational use is one of the most complicated and substantial uses in urban space that requires precise and logical attention to its location and neighborhood with similar and consistent uses. Faculties of universities are educational spaces that should be protected against physical and moral damage to create a healthy educational environment. To do this, it is necessary to find and assess the factors affecting the location of educational spaces. The extant study aimed at finding and assessing the factors affecting the location of educational spaces to locate art and architecture schools or faculties in 4 important universities. The present study is applied developmental research in terms of nature and descriptive-analytical in terms of method. This study used the AHP (Analytical Hierarchy Process) weighing and controlled the prioritization through the TOPSIS (Technique for Order Preference by Similarity) technique in the methodology phase. Since there was no criterion and metric for these centers, six were chosen as the primary metrics after reviewing the relevant theoretical foundations, early investigations, and collecting effective data. Finally, the results indicated the most important factors of vehicular or roadway access, pedestrian access, slope, parking, adjacency, neighborhood, and area. Among the mentioned factors, pedestrian access (w: 0.4231) had the highest weight and was the priority in the location of architecture faculty in studied campuses and areas inside the universities.

**Keywords:** location; architecture faculty; AHP hierarchy; TOPSIS technique

## 1. Introduction

Universities continue their lives as scientific institutions that emerged in the 12th century, constantly developing, and their importance in society is increasing daily. The most crucial development in universities was the development of sciences in the 18th century, the division into separate branches, the establishment of new faculties as each of them became self-sufficient, and the independence of various departments from within faculties. As a result of all these developments, universities have become institutions that provide conceptual and applied education in various disciplines (Karakaş and Aybike Türk, 2017).

When the settlement phases of American universities, which developed by being influenced by the changes in Europe and established a system, are examined, it is seen that the basis of the American higher education system in the Colonial period was British universities, which had a regular and disciplined system where students and faculty members lived and worked together. The quality of the campus as a place and its role as a place for different interactions have been revealed in the literature as important parameters of academic life (Donald and Denison, 2001; Büyükşahin

Sıramkaya, 2015).

Urban land use planning is the process that determines how the land can be used. Urban land use planning tends to increase social welfare regarding the constraints to achieve the highest interest under the lowest cost (Adhya, 2009). Most planners deal with the optimal distribution of uses and service centers due to a lack of appropriate spatial balance of uses caused by population growth.

On the other hand, the reputation and importance of every city depend on educational centers. “The more suitable and sufficient the quality of educational services in the right places, the lower the economic and time costs will be” (Saeedikhah, 2004). Locating is an activity that evaluates spatial and non-spatial talents of land to select the best location for specific use. An appropriate location is done when a precise, homogenous, and instant assessment of different locations’ attractions exists for a specific use. In general, location is an activity that analyzes a region’s natural and human resources for specific use (Wyatt, 2003; Lu et al., 2009). Various factors affect the location; some are constant and fixed, while others are variable and dynamic. It means that time passage and change cause no variation in these factors, such as the seismicity of the place, while the rest, such as communication factors, water resources, and vegetation, will change (Soyupak, 2021). Selecting a suitable place for an activity based on different viewpoints is crucial.

On the other hand, accurate, fair, and scale-consistent spatial distribution is the most crucial issue that must be considered in planning and locating educational spaces, especially faculties. In other words, the efficiency of faculties in universities will be improved if they are located logically, and students can use these spaces (Sarıberberoğlu, 2020). Furthermore, the rational scale allows students to meet their needs in educational centers. Therefore, lack of logical and fair distribution and lack of scale aspects in the construction of faculties are the most critical challenges for the planning and location of universities (Peker, 2010).

Certain planning principles have been decisive in forming university campuses and faculty buildings, which are important components of these campuses. Education is an open and dynamic system in close communication with its environment. An education system that can change, develop, and adapt to new situations can only be successful if it has a spatial setup designed accordingly. Universities are places where students gain a profession through academic education and where they develop themselves socially and culturally (Creswell, 2005; İsmailoğlu and Kulak Torun, 2022).

Educational and research environments, which are the main functions of university environments, are faculty buildings. In light of the developments in education today, the necessity of planning the faculty buildings within the spatial configurations that respond to the psychological and social needs of the users as well as the formal structure of education emerges. According to assessments, the common location criteria are as follows: “Roadway access, Pedestrian access, Land slope, Parking, Adjacencies, Area” (Filova et al., 2015).

Despite universities and faculties being significant and vital in education missions, reviews indicate insufficient attention to this case. Accordingly, there are fewer theoretical contents about this issue, and studies do not follow a specific and holistic mechanism in this field. According to the importance and necessity of the location of faculties in terms of core aspects, the extant study aims to assign underlying criteria for the location of faculties by using the new criteria and locational techniques.

## 2. Review of literature

In Alsubaie's (2015) research, examined and identified the factors affecting the location of the fire station using the Analytic Hierarchy Process (AHP) and multicriteria decision-making, then weighed and prioritized them. The results indicated that access, population density, nearness, natural disasters, and access factors had the most weight in fire station site selection.

In Miller's (2011) study, suggested some solutions, such as changing the use of micro-commercial activities to university-matched activities, predicting student parking, urban and traffic planning for adjacent passages, and handling the number of university clients to improve the poor and medium components "dependence and consistency" and boost the strong components "utility and capacity".

For Taherdoost's (2017) research, it was first attempted to distribute the questionnaire to assess the proportional distribution of existing parks in Amol City. In this case, after determining effective indices in locating urban parks using experts' ideas in green space, they were weighted using the AHP Model and by combining weighted indices in GIS (Geographic Information System). The suitable areas for constructing new parks in the study city were obtained. Results from the analysis of questionnaires through SPSS software indicated a highly effective proportional distribution of this use in increasing popular references to parks. Analysis of the determination of location results also showed that the distribution pattern of Amol's urban green space had not been the appropriate pattern in a new location, and the time of access to the park is more than the standard. On the other hand, the current distribution of parks is not based on the urban hierarchy (Taherdoost, 2017).

Saremi's (2014) study first used the ANP (Analytic Network Process) method in spatial distribution through Geographical Information System (GIS). This study examined and analyzed the placement site and performance range of elementary schools located in District 4 of Urmia and determined the areas outside the coverage range of existing schools using the AHP method. Then used AHP and fuzzy logic to integrate and weigh layers, criteria, and sub-criteria affecting the location of elementary schools to find the suitable and improper areas for the construction of elementary schools, especially in districts out of the coverage range of existing elementary schools (Saremi et al., 2014).

The main contribution of Zavaraqi et al.'s (2014) research is a new approach to locating public library sites based on the ideas of experts in different scopes. Moreover, this study considered the geographical features of a place but also paid attention to other features, such as consistency, efficiency, health, safety, etc (Zavaraqi et al., 2014).

Alaghemand's (2013) study showed that factors affecting the location of educational spaces included attention to proper limits of urban adjacencies, natural appearance of land, climate factors, accessibility, and capacity. Accordingly, the considered use of architecture schools in Arak City was located considering the abovementioned factors (Alaghemand et al., 2013).

Araste and Azizi's (2012) study aimed to locate residential centers in the central zone of Yazd by considering the sustainability criteria of the residential environment. According to computations of the Analytic Network Process (ANP), only five out of 13 identified factors affecting location were introduced to locate and construct sustainable residential complexes in the central zone of Yazd. These factors are "proximity to the city center and public spaces", "access to a roadway", "access to major shopping centers", "affordable land", and "lack of low land rights".

## 3. Materials

University campuses are places where the future of a society is prepared, information exchange, and various social activities are held. In this sense, planning a university is a very important socio-cultural, economic, and political event at the country level. Their role in the development and future of the country is gradually increasing. In this sense, it is necessary to examine the spatial configurations of the campuses, which are designed according to certain planning criteria, and to obtain data on their positive and negative aspects. In the field study, four old and famous universities in Iran (**Figures 1** and **2**) and Turkey (**Figures 3** and **4**), which were established close to each other, were selected as an example of university campuses and architecture faculty buildings, which were determined as the area where the effect of space configuration on social interaction would be investigated. In the table below, sample universities are determined by their brief characteristics.

University: Tahran University; Location: Iran/ Tahran; Area: 21 hektar; Established: 1934; Location of architecture faculty in campus: Southwest; Architecture: Roland Marcel Dubrulle, Andre Godar (see **Figure 1**).


**Figure 1.** Tahran University satellite image (Goggle earth, 2022).

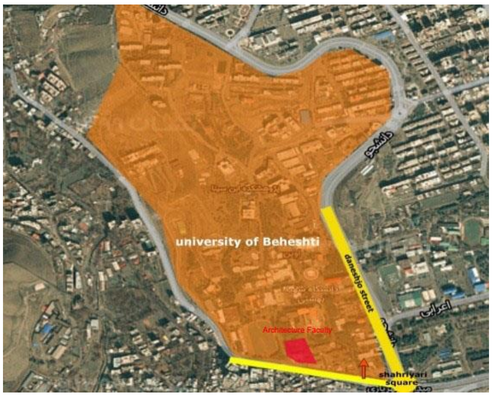


**Figure 2.** Shahid Beheshti University satellite image (Goggle earth, 2022).

University: Shahid Beheshti University; Location: Iran/ Tahran; Area: 60 hektar; Established:1958; Location of architecture faculty in campus: South (see **Figure 2**).

University: Middel East Technical University (METU); Location: Turkiye/ Ankara; Area: 45 hektar; Established: 1956; Location of architecture faculty in campus: Northeast; Architecture: Behruz Çinici, Altuğ Çinici (see **Figure 3**).


**Figure 3.** Middel East Technical University satellite image (Goggle earth, 2022).

University: Istanbul Technical University (ITU); Location: Turkiye/ Istanbul; Area: 247 hektar; Established: 1944; Location of architecture faculty in campus: Southwest; Architecture: Williams James Smith (see **Figure 4**).


**Figure 4.** Istanbul Technical University satellite image (Goggle earth, 2022).

## 4. Methodology

The extant study was applied in terms of objective, a field and descriptive study in nature, and a survey study in terms of method. The problem of locating the architecture faculty was examined using the proposed model and data analysis based on the AHP and TOPSIS techniques. This study identified and classified the relevant factors for the accurate location of faculty. Pedestrian access from the university entrance is a critical factor in the location of the faculty. Consistency indeed indicates the proportionality of a location for a specific objective. On the other hand, uses that affect each other must be matched in terms of their activities, not to interfere with their activities.

## 4.1. AHP method

The AHP method uses pairwise comparison to determine the weight of each criterion. "To do this, the considered criteria are compared, and the relative importance of each pair is ranked based on a 1–9 range. The obtained values are entered into a matrix and then assessed in a pairwise method to compare them. The normalization method weighs all measures in the second phase" (Can, 2012). The obtained weights and rates of alternatives are used in the third phase to classify all weights. Consistencies are determined based on the analyst's opinion in the final step. Therefore, the AHP method is widely used to solve complicated decision-making problems. The AHP method is one of the most comprehensive systems designed for multicriteria decision-making since this technique allows hierarchically formulating the problem. Moreover, this technique makes it possible to consider different quantitative and qualitative indicators in the problem.

## 4.2. TOPSIS method

TOPSIS method includes six steps:

- Quantifying and descaling the decision matrix;
- Weighting the normalized matrix;
- Determining the positive and negative ideal solution;
- Calculating the distance between each alternative and positive or negative ideal;
- Determining the relative similarity (cl) of an alternative to the ideal solution;
- Ranking the alternatives.

In other words, this method measures the distance between a factor and a positive or negative ideal factor, which is a criterion for rating and ranking the factors. Accordingly, the best alternative or factor must be the most similar to the positive ideal and the farthest from the negative one (Wang et al., 2006).

**Criteria:** The extant study attempted to identify the main location criteria for the faculty of architecture and found six categories as follows:

**Roadway and pedestrian access:** Proper access to educational departments is an important case that must be considered. Educational places require various vehicular and pedestrian accesses. The mentioned requirements affect the location of educational space placement (Yollu, 2006). If an educational location has been created without consideration of access, it will be vulnerable in terms of both safety aspects, which is the most significant aspect, but also threatens the health of people who come and leave the space (Sanoff et al., 2001). Educational spaces require some equipment to do their educational activities through suitable vehicular and roadway access. Therefore, all vehicles, such as ambulances and fire trucks, that provide relief must have proper access to the university.

**Land slope:** Land surface roughness affects the formation of cities and their space uses. The steep slopes and sharp unevenness prevent people from using all city surfaces for required uses. Cities deployed on any surface, including suitable or unsuitable slopes, sharp unevenness, or plain surfaces, require various urban amenities and establishments, such as educational spaces (Blatchford, 2012). However, it should be considered that educational space must be selected regarding the natural appearance of the city or village's surface roughness. This way, the surface must have the minimum slope and roughness to provide the most efficient educational activities.

**Parking:** Parking is another significant factor that must be considered. Faculties should have parking due to roadway accesses existing in the university. Parking space provides users safety and comfort (Aydın and Uysal, 2009). An essential factor is consideration of the distance between parking and faculty location, which is a way that students can arrive at parking from the faculty place within the shortest time.

**Adjacency:** The proportional adjacency between educational centers (faculties) and other university areas is an essential factor that must be considered in the location problem. The noise and neighborhood of faculties are effective factors in this case (Hajirasouli and Kumarasuriyar, 2016). The critical and effective factors in the adjacency problem include open and green spaces, the distance between faculties, and access to essential university places, such as the library, prayer room, gym, self-service, etc (Teas, 1993).

**Area:** The primary faculty area (campus) is the final criterion that must be considered in the faculty location. An architecture faculty is a place that requires classes but also various workshops, indoor and outdoor spaces for the presentation of architecture projects and doing matches and collective or individual activities (Kulak Torun and İsmailoğlu, 2022). Therefore, architecture faculties need green, open areas and suitable spaces to do such activities. Hence, the area of architecture faculty is an essential factor in its location.

## 4.3. Calculation and ranking steps

### 4.3.1. AHP technique

The scale of relative preference is shown in **Table 1** below.

**Table 1.** Relative preference.

| Preferences | Rate |
|---|---|
| Equal importance | 1 |
| Medium | 3 |
| Strong | 5 |
| Highly strong | 7 |
| Extraordinary | 9 |
| Intermediary | 2, 4, 6, 8 |

**Normalized matrix:** For each factor from the Relative Preference table, an index is determined and written as a decimal, and at the end, the sum of each factor (column) is calculated (**Table 2**).

**Calculating the weight of criteria:** First, from the Normalized Matrix table, the number obtained for each factor is divided into the total obtained in each column (**Table 3**), and then the average is taken from each factor, the obtained numbers are the weight of the criteria of each factor (**Table 4**).

**Assessing consistency and inconsistency:** To check the correctness of calculating the weight of the criteria, the numbers obtained in the Normalized Matrix table are multiplied by the weight of the criteria of each column (one by one in the cells of the columns), and the result is written in the cells of each indicator, and then the sum of each row is calculated to the sum of the Weighted Values of each specify the invoice (**Tables 5** and **6**).

**Table 2.** Normalized matrix.

| Factors | Roadway access | Pedestrian access | Land Slope | Parking | Adjacency | Area |
|---|---|---|---|---|---|---|
| Roadway access | 1 | 0.5 | 4 | 2 | 6 | 5 |
| Pedestrian access | 2 | 1 | 7 | 8 | 5 | 6 |
| Land slope | 0.25 | 0.14 | 1 | 0.33 | 0.33 | 0.5 |
| Parking | 0.5 | 0.12 | 3 | 1 | 5 | 8 |
| Adjacency | 0.16 | 0.2 | 3 | 0.2 | 1 | 0.5 |
| Area | 0.2 | 0.16 | 2 | 0.12 | 2 | 1 |
| Total | 4.11 | 2.12 | 20 | 11.65 | 19.33 | 21 |

**Table 3.** Calculating the weight of criteria.

| Factors | Roadway access | Pedestrian access | Land slope | Parking | Adjacency | Area | Total |
|---|---|---|---|---|---|---|---|
| Roadway access | 0.2433 | 0.2358 | 0.2000 | 0.1716 | 0.3103 | 0.2380 | 1.3990 |
| Pedestrian access | 0.4866 | 0.4716 | 0.3500 | 0.6866 | 0.2586 | 0.2857 | 2.5391 |
| Land slope | 0.0608 | 0.0660 | 0.0500 | 0.0283 | 0.0170 | 0.0238 | 0.2459 |
| Parking | 0.1216 | 0.0566 | 0.1500 | 0.0858 | 0.2586 | 0.3809 | 1.0535 |
| Adjacency | 0.0389 | 0.0943 | 0.1500 | 0.0171 | 0.0517 | 0.0238 | 0.3758 |
| Area | 0.0486 | 0.0754 | 0.1000 | 0.0103 | 0.1034 | 0.0476 | 0.3853 |

**Table 4.** Criteria's weights.

| Roadway access | Pedestrian access | Land slope | Parking | Adjacency | Area |
|---|---|---|---|---|---|
| 1.3990 ÷ 6 = 0.2331 | 2.5391 ÷ 6 = 0.4231 | 0.2459 ÷ 6 = 0.0409 | 1.0535 ÷ 6 = 0.1755 | 0.3758 ÷ 6 = 0.0626 | 0.3853 ÷ 6 = 0.0642 |

**Assessing consistency and inconsistency:** To check the correctness of calculating the weight of the criteria, the numbers obtained in the Normalized Matrix table are multiplied by the weight of the criteria of each column (one by one in the cells of the columns), and the result is written in the cells of each indicator, and then the sum of each row is calculated to the sum of the Weighted Values of each specify the invoice (**Tables 5** and **6**).

**Table 5.** Normalized matrix tables are multiplied by the weight of the criteria of each column.

| Factors | Roadway access | Pedestrian access | Land slope | Parking | Adjacency | Area | Total |
|---|---|---|---|---|---|---|---|
| Roadway access | 0.2331 | 0.2115 | 0.1636 | 0.3510 | 0.3756 | 0.3210 | 1.6558 |
| Pedestrian access | 0.4662 | 0.4231 | 0.2863 | 1.4040 | 0.3130 | 0.3852 | 3.2778 |
| Land slope | 0.0582 | 0.0592 | 0.0409 | 0.0579 | 0.0206 | 0.0321 | 0.2689 |
| Parking | 0.1165 | 0.0507 | 0.1227 | 0.1755 | 0.3130 | 0.5136 | 1.2920 |
| Adjacency | 0.0372 | 0.0846 | 0.1227 | 0.0351 | 0.0626 | 0.0321 | 0.3743 |
| Area | 0.0466 | 0.0676 | 0.0818 | 0.0210 | 0.1252 | 0.0642 | 0.4064 |

**Table 6.** Divides the weighted sum of each factor into the weight of the corresponding criterion.

| Factors \ Weight | Sum of weighted values (M) | Weights of criteria (K) | Q: $\frac{M}{K}$ |
|---|---|---|---|
| Roadway access | 1.6558 | 0.2331 | 6.1033 |
| Pedestrian access | 3.2778 | 0.4231 | 7.7471 |
| Land slope | 0.2689 | 0.0409 | 6.5745 |
| Parking | 1.2920 | 0.1755 | 7.3618 |
| Adjacency | 0.3743 | 0.0626 | 5.9792 |
| Area | 0.4064 | 0.0642 | 5.3302 |

**Consistency Index (C.I):** To calculate the compatibility index, the sum of the Q's obtained is divided by the factor number 6, which is the number of factors. The result obtained in the compatibility index formula is calculated according to the number of 6 factors.

$$\lambda_{max}=\frac{6.1033+7.7471+6.5745+7.3618+5.9792+5.3302}{6}=\frac{39.0961}{6}=6.5160$$

$$\text{Consistency Index (C.I)}\rightarrow\text{C.I: } \frac{\lambda_{max}-n}{n-1}=\frac{6.5160-6}{6-1}=0.1032$$

**Consistency Rate (C.R):** Considering that the number of factors selected in this article is 6, the number 1.24 is selected from the table for the AHP method (**Table 7**), and the obtained result of the compatibility index is divided by the number 1.24, and the result should be less than one-tenth. The calculations show that the numbers of the selected weight criteria are less than one-tenth and are actually consistent. The results indicate that the values of weighted criteria are accurate and consistent.

**Table 7.** AHP method.

| n | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|
| **R.I** | 1.49 | 1.45 | 1.41 | 1.32 | 1.24 | 1.12 | 0.9 | 0.58 | 0 | 0 |

$$C.R=\frac{C.I}{R.I}=\frac{0.1032}{1.24}=0.0832$$

### 4.3.2. TOPSIS technique

In this method, to start the calculations, first, based on the importance of each factor in each university, **Table 8** is determined as follows. The numbers 1 to 9 determined in this method, number 9 shows the highest score (the most suitable), and 1 shows the lowest score compared to the university (the most unsuitable). The sum of the squares of each column is calculated, and the square root is taken from them (**Table 9**).

**Table 8.** Factor preference.

| University \ Factors | Roadway access | Pedestrian access | Land slope | Parking | Adjacency | Area |
|---|---|---|---|---|---|---|
| Tahran University | 9 | 9 | 3 | 5 | 2 | 4 |
| Shahid Beheshti University | 7 | 6 | 1 | 3 | 5 | 7 |
| Middel East Technical University | 3 | 2 | 1 | 4 | 7 | 5 |
| Istanbul Technical University | 3 | 3 | 1 | 4 | 6 | 7 |

**Table 9.** Square root from the sum of the squares of each column.

| Formula \ Factors | Roadway access | Pedestrian access | Land slope | Parking | Adjacency | Area |
|---|---|---|---|---|---|---|
| $\sqrt{\sum_{j=1}^{n} x_{ij}^{z}}$ | 148 = 9 + 9 + 49 + 81$\sqrt{148}$=12.1655 | 125 = 4 + 4 + 36 + 81$\sqrt{125}$=11.1803 | 12 = 1 + 1 + 1 + 9$\sqrt{12}$=3.4641 | 66 = 16 + 16 + 9 + 25$\sqrt{66}$=8.1240 | 114 = 36 + 49 + 25 + 4$\sqrt{114}$=10.6770 | 139 = 49 + 25 + 49 + 16$\sqrt{139}$=11.7898 |

**Normalized matrix:** The numbers obtained from the calculation results of the above factors are divided into the numbers of each column (relevant factor) one by one (**Table 10**).

**Table 10.** Normalized matrix.

| University \ Factors | Roadway access | Pedestrian access | Land slope | Parking | Adjacency | Area |
|---|---|---|---|---|---|---|
| Tahran University | 0.7397 | 0.8049 | 0.8660 | 0.6154 | 0.1873 | 0.3392 |
| Shahid Beheshti University | 0.5753 | 0.5366 | 0.2886 | 0.3692 | 0.4682 | 0.5937 |
| Middel East Technical University | 0.2465 | 0.1788 | 0.2886 | 0.4923 | 0.6556 | 0.4240 |
| Istanbul Technical University | 0.2465 | 0.1788 | 0.2886 | 0.4923 | 0.5619 | 0.5937 |

**Criteria's weights creation of each University:** The numbers of each cell in each column are multiplied and calculated by the weight of the corresponding criterion obtained in the ahp method (**Table 11**).

**Table 11.** Criteria's weight creation.

| University \ Factors | Roadway access | Pedestrian access | Land slope | Parking | Adjacency | Area |
|---|---|---|---|---|---|---|
| Tahran University | 0.1724 | 0.3405 | 0.0354 | 0.1080 | 0.0117 | 0.0217 |
| Shahid Beheshti University | 0.1341 | 0.2270 | 0.0118 | 0.0647 | 0.0293 | 0.0381 |
| Middel East Technical University | 0.0574 | 0.0756 | 0.0118 | 0.0863 | 0.0410 | 0.0272 |
| Istanbul Technical University | 0.0574 | 0.0756 | 0.0118 | 0.0863 | 0.0351 | 0.3810 |

**Calculating the distance between the positive and negative ideal:** To calculate the best and worst factor from the ideal, it is calculated in such a way that the smallest number (negative) and the largest number (positive) are selected in each university (**Table 12**).

**Table 12.** Positive and negative ideal.

| University | Distance | Number (Largest, smallest) |
|---|---|---|
| Tahran University | Distance from the positive ideal | 0.3405 |
| | Distance from the negative ideal | 0.0117 |
| Shahid Beheshti University | Distance from the positive ideal | 0.2270 |
| | Distance from the negative ideal | 0.0118 |
| Middel East Technical University | Distance from the positive ideal | 0.0863 |
| | Distance from the negative ideal | 0.0118 |
| Istanbul Technical University | Distance from the positive ideal | 0.3810 |
| | Distance from the negative ideal | 0.0118 |

**Positive ideal:** To calculate the positive ideal distance of the four universities' highest state of all factors, the sum of the squares of the difference of the largest number of each factor is obtained, and then the square root is taken (**Table 13**).

**Table 13.** Positive ideal distance of the four universities.

| University | Distance from the positive ideal |
|---|---|
| Tahran University | $(0.1724–0.3405)^2+(0.3405–0.3405)^2+(0.0354–0.3405)^2+(0.1080–0.3405)^2+(0.0117–0.3405)^2+(0.0217–0.3405)^2=\sqrt{0.3849}=0.6204$ |
| Shahid Beheshti University | $(0.1341–0.2270)^2+(0.2270–0.2270)^2+(0.0118–0.2270)^2+(0.0647–0.2270)^2+(0.0293–0.2270)^2+(0.0381–0.2270)^2=\sqrt{0.1558}=0.3947$ |
| Middel East Technical University | $(0.0574–0.0863)^2+(0.0756–0.0863)^2+(0.0118–0.0863)^2+(0.0863–0.0863)^2+(0.0410–0.0863)^2+(0.0272–0.0863)^2=\sqrt{0.0118}=0.1086$ |
| Istanbul Technical University | $(0.0574–0.3810)^2+(0.0756–0.3810)^2+(0.0118–0.3810)^2+(0.0863–0.3810)^2+(0.0351–0.3810)^2+(0.3810–0.3810)^2=\sqrt{0.5406}=0.7352$ |

**Negative ideal:** To calculate the minimum negative ideal distance of all the factors of all four universities, the sum of the squares of the difference of the smaller number of each factor is obtained and then the square root is taken (**Table 14**). In this way, two positive and negative numbers are assigned for each academic case.

**Table 14.** Negative ideal distance of the four universities.

| University | Distance from the negative ideal |
|---|---|
| Tahran University | $(0.1724–0.0117)^2+(0.3405–0.0117)^2+(0.0354–0.0117)^2+(0.1080–0.0117)^2+(0.0117–0.0117)^2+(0.0217–0.0117)^2=\sqrt{0.1437}=0.3790$ |
| Shahid Beheshti University | $(0.1341–0.0118)^2+(0.2270–0.0118)^2+(0.0118–0.0118)^2+(0.0647–0.0118)^2+(0.0293–0.0118)^2+(0.0381–0.0118)^2=\sqrt{0.0648}=0.2545$ |
| Middel East Technical University | $(0.0574–0.0118)^2+(0.0756–0.0118)^2+(0.0118–0.0118)^2+(0.0863–0.0118)^2+(0.0410–0.0118)^2+(0.0272–0.0118)^2=\sqrt{0.0125}=0.1118$ |
| Istanbul Technical University | $(0.0574–0.0118)^2+(0.0756–0.0118)^2+(0.0118–0.0118)^2+(0.0863–0.0118)^2+(0.0351–0.0118)^2+(0.3810–0.0118)^2=\sqrt{0.1483}=0.3850$ |

**Rating:** For each university, the negative ideal is first divided by the total of positive and negative ideals. The obtained numbers are determined for each case, and based on that, the numbers are sorted from large to small. Bigger numbers are higher and more suitable and smaller numbers are lower and less suitable (**Table 15**).

**Table 15.** Rating for each university.

| University | $S_i^-$ | $S_i^+ + S_i^-$ | $P_i = \frac{S_i^-}{S_i^+ + S_i^-}$ |
|---|---|---|---|
| Tahran University | $S_i^-=0.3790$ | $S_i^+ + S_i^-= 0.9994$ | $P_i = \frac{0.3790}{0.9994}=0.3792$ |
| Shahid Beheshti University | $S_i^-=0.2545$ | $S_i^+ + S_i^-=0.6492$ | $P_i = \frac{0.2545}{0.6492}=0.3920$ |
| Middel East Technical University | $S_i^-=0.1118$ | $S_i^+ + S_i^-=0.2204$ | $P_i = \frac{0.1118}{0.2204}=0.5072$ |
| Istanbul Technical University | $S_i^-=0.3850$ | $S_i^+ + S_i^-=1.1202$ | $P_i = \frac{0.3850}{1.1202}=0.3436$ |

Based on the obtained data, such an arrangement can be made for the four mentioned universities: Middel East Technical University; Shahid Beheshti University; Tahran University; Istanbul Technical University.

## 5. Conclusion and recommendations

Based on the data obtained from prioritizing the location criteria based on the Topsis and AHP methodology, which was evaluated comparatively in the relevant tables. Among the reference criteria, the pedestrian access factor with the highest weighted score is one of the basic indicators in determining the location of the college.

Due to the fact that Colleges are considered important educational centers and educational services, and on the other hand, they have a significant impact in creating suitable fields for acquiring new knowledge and producing science, so the main factors mentioned in the direction of services, the provision and comfort of students as much as possible have always been of special importance. In this research, its various qualitative and quantitative dimensions have been considered. Examining the analysis shows that the spatial distribution of faculties has always been one of the critical factors in architectural design.

Several factors have been influential in the location of colleges, but the surveys show that access to the college on foot is more important than other factors.

- In the location of colleges, after walking and riding access to the place, neighborhoods, parking areas, and topography were ranked next.
- Spatial division, access, and circulation of people in the university in general and in architecture faculties in particular have significantly impacted the location and placement of architecture.
- In the analysis of the samples, the placement of the faculty of architecture at Middle East Technical University has been more successful based on the measured criteria with a significant difference compared to the faculty of architecture of Shahid Beheshti, Tehran, and Istanbul Technical Universities.
- The placement of the three Shahid Beheshti University of Tehran University and Istanbul Technical University were ranked as follows: close to each other and with a small difference.

In the end, it can be noted that the importance of location in architectural design and the feeling of satisfaction of users, especially in the placement of faculties, is a sensitive and influential item, and in such designs, the need for such location analysis and measurement is felt more than ever.

This study mainly used AHP (Analytical Hierarchy Process), and priority was controlled by TOPSIS (Technique for Order Preference by Similarity). Six main parameters and measures were evaluated accordingly. As a result of these analyses, transportation, spatial belonging, and neighborhood issues will be considered in the designed campuses, and the settlements will be adjusted more appropriately. Other proposed campus designs will be evaluated and analyzed using this method.

**Author contributions:** Conceptualization, PD, HO, UA; design, PD, HO, UA methodology, PD, HO, UA; data collection and/or processing, PD, HO, UA; data analysis and/or interpretation, PD, HO, UA; literature review, PD, HO, UA; writing,

PD, HO, UA; critical review, PD, HO, UA; submission and revision, PD, HO, UA; project management, PD, HO, UA. All authors have read and agreed to the published version of the manuscript.

**Acknowledgments:** This article is taken from the Phd thesis prepared by Parisa Doraj, under the supervision of Prof. Dr. Havva Özyılmaz, at the Department of Architecture, Graduate School of Natural and Applied Sciences, Dicle University in Turkiye.

**Conflict of interest:** The authors declare no conflict of interest.

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