ASSESSMENT OF INFLUENCES AMONG CLASSICAL TURKISH MUSIC COMPOSERS: A SOCIAL NETWORK ANALYSIS

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Approval of the Institute of Social Sciences

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ABSTRACT

ASSESSMENT OF INFLUENCES AMONG CLASSICAL TURKISH MUSIC COMPOSERS: A SOCIAL NETWORK ANALYSIS

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Composers are important figures in society. Their works are admired and give pleasure to people who enjoy listening to music. In this research, we focus on assessing influence among classical Turkish music composers. There is a common understanding that classical Turkish music, rooted in Ottoman classical music, emerged from and is improved upon in Enderun, Mehterhane-yi Hümâyûn, Muzıkay-ı Hümâyûn, Mevlevihanes, and other music schools. Contrary to the style of western classical music, classical Turkish music is based on a different training technique, namely the Meşk system. We use a novel dataset gathered from Oktar (2009). The website was built by Remzi Oktar (Vocal Artist of Turkish Art Music in Radio of TRT Ankara) with contributions from music lovers. This archive depends on TRT sources. In this study, for the purpose of achieving better visualization, higher interpretative power, and a focus on the periods that are highly important in the development of classical Turkish music, data of composers who were born before 1901 and have at least 12 works were used. As a result, 99 unique composers are included in the social network analysis. Also, 181 unique maqams and 136 unique tempos

are used by the composers in our data. From a methodological point of view, common network analysis techniques including degree centrality, eigenvector centrality, betweenness centrality, average weighted degree, modularity, and page-rank are applied in this study. As a social network analysis tool, Gephi Software, was chosen to illustrate and visualize data. In addition to the mentioned indicators, we also consider periods, locations, schools, workplaces, and nationalities of the composers to further interpret the network. Moreover, relationships among composers are measured using information that includes composer-teacher networks and composer networks from Öztuna (1990). Next, relationships among composers are calculated using maqam, tempo, and the combination of maqam and tempo similarity with Python software to reveal the composers' influence on each other. To measure maqam and tempo similarity, cosine similarity index is performed. Data of maqam and tempo, which are used by composers, are treated as of word groupings. Accordingly, the number of each maqam and tempo used by composers are taken into consideration to compute similarity. Maqam and tempo are important indicators since these are transferred from teacher to student through the Meşk system that lies at the core of education in classical Turkish music. The analysis, comparison, and interpretation are based on the information extracted from the encyclopedia (Öztuna, 1990) and the values of maqam and tempo similarity of composers. Based on the results of this study, important figures of classical Turkish music and areas where creativity occurs are revealed that provide a broader perspective for people who will study in this area in future.

Keywords: Assessment, Classical Turkish Music, Composer, Influence, Maqam, Meşk, Music, Social Network Analysis, Similarity, Tempo

ÖZET

KLASİK TÜRK MUSİKİSİ BESTEKARLARI ARASINDAKİ ETKİLERİN DEĞERLENDİRİLMESİ: SOSYAL AĞ ANALİZİ

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Bestekarlar toplumda önemli figürlerdir. Bestekarların çalışmaları müzik dinlemekten zevk alan kişileri eğlendirir ve takdir görür. Bu çalışmada, Klasik Türk Musikisi bestekarları arasındaki etkileşimlerin anlamlı yorumlamalar yaparak çalışılmasına odaklandık. Klasik Türk Musikisinin Osmanlı Klasik Musikisine dayandığı, Enderun, Mehterhane-yi Hümâyûn, Muzıkay-ı Hümâyûn, Mevlevihaneler ve müzik okullarında ortaya çıkıp geliştiği yaygın bir anlayıştır. Klasik Batı Müziğindeki özelliklerin aksine, Klasik Türk Musikisi Meşk sistemi adı verilen farklı bir eğitim tekniğini içermektedir. Oktar (2009)'ın web sitesinden alınan özgün bir veri kümesini kullanmaktayız. Web sitesi Remzi Oktar (TRT Ankara Radyosu Türk Sanat Müziği Ses Sanatçısı) tarafından müzik severlerin katkılarıyla kurulmuştur. Bu arşiv TRT kaynaklarına dayanmaktadır. Bu çalışmada daha iyi görselleştirme ve yüksek yorumlama gücüne ulaşabilmek amacıyla, 1901'den önce doğan ve en az 12 bestesi olan bestekarların verileri kullanılmıştır. Sonuç olarak, sosyal ağ analizi için 99 tane eşsiz bestekar elimizde kalmıştır. Ayrıca, verimizdeki bestekarlar

tarafından 181 eşsiz makam ve 136 eşsiz usul kullanılmıştır. Yöntemsel bakış açısına göre bu çalışmada, Derece Merkeziliği, Özvektör Merkeziliği, Arasındalık Merkeziliği, Ortalama Ağırlık Merkeziliği, Modülerlik ve PageRank gibi yaygın ağ analizi teknikleri uygulanmıştır. Gephi yazılımı sosyal ağ analizi aracı olarak veriyi sergilemek ve görselleştirmek için seçilmiştir. Bahsedilen göstergeçlere ek olarak, biz ayrıca bestekarların dönemlerini, yerlerini, okullarını, iş yerlerini ve uyruklarını ağı daha ileri seviyede yorumlayabilmek için dikkate aldık. Buna ek olarak, bestekarların ilişkileri Öztuna (1990)'dan alınan, bestekar öğretmen ağı ve bestekarlar ağını içeren bilgiler aracılığıyla ölçülmüştür. Sonrasında, bestekarların birbirlerine olan etkilerini ortaya çıkarmak için makam, usul ve makam ve usulün birleşimini içeren verilerle birbirlerine olan benzerliklerine bakarak, bestekarların ilişkilerini Python yazılımı ile hesapladık. Makam ve usul benzerliğini ölçebilmek için kosinüs benzerliği indeksi uygulanmıştır. Bestekarların kullandığı makam ve usul verileri kelime torbası olarak düşünülmüştür. Dolayısıyla, bestekarların kullandıkları her bir makam ve usullerin sayıları benzerlik hesaplamasında dikkate alınmıştır. Klasik Türk Musikisi eğitiminin merkezinde yatan meşk sistemi aracılığıyla öğretmenden öğrenciye aktarılan makam ve usuller önemli belirteçlerdir. Analizde, ansiklopediden (Öztuna, 1990) alınan bilgilere ve bestekarların makam ve usul benzerliği değerlerine dayandırılarak karşılaştırma ve yorumlama yapılmıştır. Bu çalışmanın sonuçlarına istinaden, Klasik Türk Musikisinin önemli figürlerinin ve yaratıcılığın oluştuğu yerlerin ortaya çıkarılmış olması gelecekte bu alanda çalışacak olan kişilere geniş bir bakış açısı sağlamaktadır.

Anahtar Kelimeler: Bestekar, Benzerlik, Değerlendirme, Etki, Klasik Türk Musikisi, Makam, Meşk, Müzik, Sosyal Ağ Analizi, Usul

To My Parents and Dear Atibisi

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LIST OF ABBREVIATIONS

TRT	Turkish Radio and Television Corporation
SNA	Social Network Analysis

CHAPTER 1

INTRODUCTION

Ottoman classical music is known as classical Turkish music. It is thought that important improvements in classical Turkish music started in the middle of the 17th century. Toker and Özden (2013) state that music education is lectured in various institutions countrywide in the Ottoman Empire. Enderûn-ı Hümâyûn, Mehterhâne-yi Hümâyûn, Muzıkay-ı Hümâyûn, Mevlevihane, and other music schools opened after the Imperial Edict of Reorganization are the most popular ones (Toker and Özden, 2013). In this Ecole, the Meşk system had been applied. The Meşk (exercise) is based on the practicing and memorizing principles unique to particular performance, tempo, and maqam with listening methods. The Meşk tradition improved the talent of sensing for listening musicians, but aggregation based upon memory had not been transferred to the next generation since notes had not been used. Many compositions today derived from the Meşk system, but there are thousands of works in the archives that were composed since the beginning of the 20th century, but it is thought that the number of works that disappeared due to the lack of notes is higher than known (Öztuna, 1990). Sultan III. Selim (1761-1808), the former Sultan of the Ottoman Empire and a composer, had encouraged musicians to solve notation problems. This caused many notations to be developed, and subsequently resulted in the decision to use a new system closest to that which was used in the second half of the 19th century in classical music. Thanks to these efforts, there are pieces today, both with and without lyrics, with notes.

It is thought that a teacher influences his student significantly by the virtue of the nature of the Meşk system. Based on this implication, in this study, we focus on influences among classical Turkish music composers born in the Ottoman Empire before 1901. Our purpose is to reveal the social network of these composers, and then assess the influences among them.

The main motive of this research is to identify and differentiate teaching techniques in classical music and classical Turkish music. Showing the social structures of classical Turkish music composers visually and assessing the influences among them will help researchers who are interested in this area and illuminate a path for future studies. In literature, there are many studies that reveal information about relationships among composers, productivity of composers, and important actors in the composer communities by analyzing social structures among artists. Heckathorn and Jeffri (2001) studied the social networks of jazz musicians. Crossley (2009) studied network dynamics in Manchester's post/punk music from 1976 to 1980. O'Hagan and Borowiecki (2010) analyzed the importance of birth locations and migration patterns of the most prominent composers identified by Murray (2003). Moreover, Borowiecki (2013) studied geographic clustering and productivity of classical composers. Furthermore, Borowiecki (2015) revealed peer effects within the music. McAndrew and Everett (2014) studied British female composers to analyze why women are under-represented in classical music composition. McAndrew and Everett (2015) analyzed the social networks of composers in Britain. Park et al. (2015) studied topology and evolution of the network of western classical music composers. In the current literature covering western classical music composers, composers in Britain, communities in particular cities, jazz musicians, and Manchester's post/punk music composers were studied, but the mystery of classical Turkish music composers has not yet been examined. Moreover, none has focused on analysis of the relationships of classical Turkish music composers using social network analysis techniques. Furthermore, this study creates a foundation for the understanding of classical Turkish music with its new approaches.

This study answers the following research questions:

- Did the periods that composers lived in affect their relationships?
- Which is the most important location for classical Turkish music composers?
- Was geographic clustering of classical Turkish music composers important for them?
- Which are the most significant schools and workplaces for classical Turkish music?
- Did the nationalities of the composers affect their influences?
- Were composers influenced by their teachers and networks?

- Who were the most prominent classical Turkish music composers?

To answer the research questions, we gathered information from the Encyclopedia of Great Turkish Music (Öztuna, 1990), then analyzed the data using the Gephi program. The research questions are discussed in the methodology chapter.

Most importantly, we assume that maqam and tempo similarities among composers reflect their social networks and influences.

The order of information is described as follows. The next chapter provides the theoretical framework. Subsequently, chapter 3 includes the methodology, which primarily reviews Enderun and Mevleviyye, the literature of social network analysis, music education in classical Turkish music, the structures of compositions that are maqams, tempos, and forms, and data used in this research. Important indicators such as locations, schools, workplaces, and nationalities of composers are analyzed. Then, composer-teacher and composer-network frameworks are revealed with information gathered from the Encyclopedia of Great Turkish Music (Öztuna, 1990). Moreover, maqam, tempo, and maqam and tempo similarity among composers are found using cosine similarity measures. Furthermore, in the findings chapter, each composer is analyzed in detail, showing similarities among them. The thesis ends with a conclusion chapter.

CHAPTER 2

THEORETICAL FRAMEWORK

In this section, theoretical framework of this research is discussed in terms of tacit and explicit knowledge and studies on music with social network analysis are analyzed.

2.1. Tacit and Explicit Knowledge

Hall and Andriani (2003) clarified tacit and explicit knowledge by explaining with observing conditions by noting "until the system of bass and treble clef notation was devised the knowledge of music could only be acquired by direct experience". In their study, they argued musical knowledge shifted from tacit to explicit in the 12th century. They also showed Knowledge Space in the Figure 1 adapting from Nonaka (1994) and Boisot (1995). In the graph, the transformation of knowledge is given. They analyzed the transmission of the knowledge one to one and many to one in the socialization part. Transmission and enhancement of folk music are done with sharing experience; and trying to capture the folk music knowledge on musical notes limits its nature badly (Hall and Andriani, 2003).

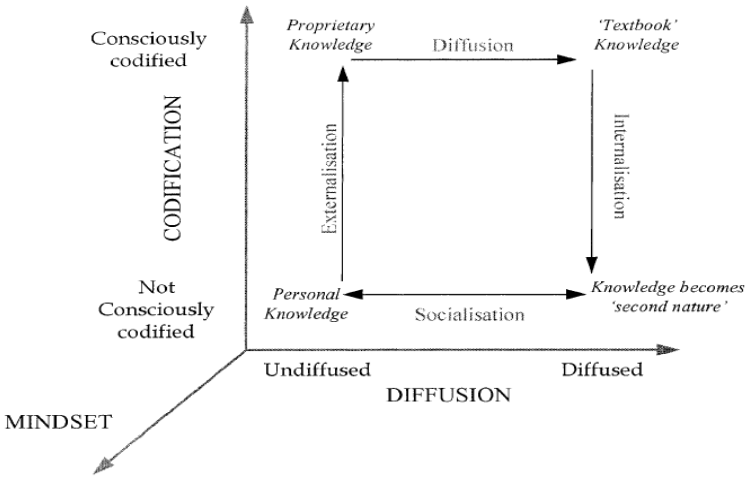


Figure 1 Knowledge Space, Hall and Andriani (2003)

As we mentioned before, with the help of encouraging that came from III. Selim notation system had been constituted, but the composers had chosen to apply the Meşk system in the transmission of musical knowledge. The reason for this action is that they believe if they use notation, emotion and nuance of the works would be destroyed like in the example of Hall and Andriani (2003) about folk music transmission. Medieval chant is transmitted with neumatic notations which involves details about a song, but lacks knowledge about the speed of singing, vocal production in music, and singing style like loudly, sing softly, nasally, gutturally, and with or without vibrato etc. (Cook, 2000).

Cook (2000) clarified highly important points about notation, and he deduced that the sound of music in the earliest time cannot be same as it comes to today. But, we know that the Meşk system can falsify this argument, since a work which reach the present day have been transmitted constantly in Classical Turkish Music. On the other hand, if a notation system had been used properly in the early centuries in Classical Turkish Music, more works of the composers would have been reached today. For example, Öztuna (1990) indicated that Itri (Buhurizade Mustafa Efendi) (1638-1712) composed over one thousand works, but only 42 of them have reached today. As it is known that Itri and western music composer, famous Johann Sebastian Bach (1685-1750) had lived in the same periods. Bach's 1128 composition (Bach Digital, 2016) have reached the present day, only 23 works were lost or unfinished. Also, categorizing of Bach works has been conducted by the relevant institutions. The numbers show that if notation were used efficiently in classical Turkish music, most of the compositions of Itri may have reached today, and Itri could have been respected more. We must also state that "Tekbir, Saying Allahuekber of Bairam" composition of Itri, that includes one sentence, is worldwide known and it is sung by Muslims in the Bairam. Öztuna (1990) noted that this piece can be accepted the supreme masterwork of classical Turkish music. Also, we did not use any important composers in our data since the number of their works was under the minimum level that we determined for gathering better visualization and making better interpretation. The inefficient use of the notation system in classical Turkish music is the main motive of our research for revealing the influences of the composers on each other.

2.2. Studies in Music with Social Network Analysis

In this section, important studies in music, which enlighten our way in this research, with social network analysis in the literature are discussed in general terms.

Music is analyzed as social relations in a work of Schütz (1951). Social interactions in the musical activities depends on communication most of all, not primarily on musical notation which is just one tool of communication in musical expression (Schütz, 1951). Moreover, Schütz (1951) discussed that face to face relationship is the basis of making music together. Furthermore, Bennett (1980) argued that the learning to play rock music is done with face to face transmission. Besides, social interactions are important in the music world since composers gather tacit and formal musical knowledge from their networks. Especially, in our case, the Meşk system, which includes the transfer of tacit knowledge, is directly related to the face to face relationship between teacher and his student. Therefore, transmission of tacit knowledge holds a strict position in classical Turkish music. Tacit knowledge is explained in the theoretical framework chapter in more detail.

As it is seen above, the study of Schütz (1951) in sociology of music tended to analyze the social interactions in the musical process. On the other hand, Bennett (1980) focused on what makes somebody a rock musician from the learning process to the performance and interactions with the audience. Even more, Becker (1982) analyzed music, painting, etc. as a product of a social structure which he called art world and laid emphasis on the importance of collaborations among artists. The work of Becker (1982) influenced on further researches about musical communities strongly, for instance, Hollywood, blues, jazz etc. (Shepherd and Devine, 2015).

Furthermore, Faulkner (1983) analyzed works and careers of Hollywood studio musicians by using social network analysis techniques and focused on musicians who produce works. The main difference of the study of Faulkner (1983) is the focus on artists rather than content that earlier researchers studied.

The tendency to focus on the artists in early studies were narrowed down and such as the study of musical activities in determining local places evolved with the analysis of

Finnegan (1989) and Cohen (1995). Finnegan (1989) in his case examined local urban community musicians in the English town of Milton Keynes. Moreover, Cohen (1995) studied the relations between music and place in Liverpool with the social network on a one individual. Music has a highly important role for places in social and cultural production (Cohen, 1995).

On the contrary, focusing on local musicians, Heckathorn and Jeffri (2001) studied the use of respondent-driven sampling (RDS) to identify and survey jazz musicians for opening the way for analyzing the complex social structure among jazz musicians. Moreover, homophily, which is the tendency of a person to bond each other by similarity, is used as a measure for network clustering. Besides, Crossley (2009) analyzed the network dynamics in Manchester's post/punk music scene 1976–1980 to demonstrate network formation in the UK music scene that triggered the progress of alternative music in Europe. McAndrew and Everett (2014) studied British Female Composers with social network analysis. Then, McAndrew and Everett (2015) studied British classical music composers who born between 1870 and 1969 to show the British composer network and its structure, and special movements which may have a relation to the connections in the all network. Moreover, it is shown that networks are important for three causes which are transmitting knowledge, innovation quantity of special positions in the network, and helping in developing new information. Furthermore, the relation between centrality and productivity of each composer is examined by using the number of their works. Besides, Park, Bae, Schich, and Park (2015) analyzed the basic features of CD-composer and composer networks among western classical music composers and found that their characteristics are common to real world networks involving small world feature. It is also proposed that the creation and transmission of cultural works are directly related to network phenomena like in our case.

The studies about clustering of composers are particularly made by O'Hagan and Borowiecki (2010, 2012). Such as, O'Hagan and Borowiecki (2010) outlined and examined clustering of 522 most prominent composers identified by Murray (2003) with their birth location and migration patterns. Moreover, Borowiecki and O'Hagan (2012) added knowledge to the results of O'Hagan and Borowiecki (2010) at a valuable level, by covering more composers and key cities, professional, work types, and music instruments

are identified. Furthermore, Borowiecki (2013) in this study of the instrumental variable approach, argued that geographic clustering effects productivity. Composers in cities improve their abilities by way of face-to-face relations among each other (Borowiecki, 2013).

Afterward, Borowiecki (2013) applied the theory of Porter (1990), in a city that composers clustered; being the best is very competitive and hard because there is a race between them to produce the best work. In this competitive environment, work number increase and works must have a quality to be respected. Accordingly, it is shown that composers who studied in a geographic cluster produced more works. Also, it is indicated that migrant composers' productivity increased after they moved to Paris. Besides, it is found that location is highly effective for the productivity of composers. Additionally, Borowiecki (2015) examined peer effects in a great variety of cities for 116 prominent composers born between 1750 and 1899.

Especially, collaboration among artists is important in the modern era of music to produce better works. Being in a productive network, which has knowledge sharing contributes to the improvement of companies as it is analyzed in Allen (1983) as collective invention. Mattessich and Monsey (1992) defined that "collaboration is a mutually beneficial and well-defined relationship entered into by two or more organizations to achieve common goals" (p. 11). The focus was on companies in the researches of Allen (1983) and Mattessich and Monsey (1992). But, we can think artists as companies today since music companies create new music for artists in a collaboration. Accordingly, Yim, Shaw, and Bartram (2009) visualized collaborations of popular musicians with registered recordings from 1950. Similarly, Budner and Grahl (2016) studied the collaborative networks in the music industry to find the social network behind the successful works.

As it is seen above, almost all music genres are studied to demonstrate and analyze the social networks behind different musical works except classical Turkish music. Besides, cosine similarity is used as the measure for the first time in a research to reveal similarity among composers. In the light of the theoretical chapter, it is found that there are no researches in the literature similar to assessment of influences among classical Turkish music Composers.

CHAPTER 3

METHODOLOGY

For better understanding of social network analysis, we must firstly understand the meaning of social network. Its name gives clue about its definition. The social network is a structure which includes social members like people, organization, etc. In a social network, social members are nodes which are connected to each other in specific conditions.

We have identified network actors as classical Turkish music composers in our case. After that relations among composers are identified, such as maqam and tempo similarities, schools, locations, workplaces, nationalities, etc. Information flows among composers are analyzed with student teacher relationship, social relations, and maqam and tempo similarity which composers used in their works.

In this chapter, firstly, literature of social network analysis is reviewed. Secondly, information about Enderun and Mevleviyye is given. Thirdly, information about music education in classical Turkish music is reviewed. Then, maqams, tempos, and forms, which are the essential components of the compositions in classical Turkish music, are reviewed. After, data that are used in this research is examined. Subsequently, periods, locations, schools, workplaces, and nationalities of composers are analyzed. Then, the relations among composers are measured and analyzed via information from the Encyclopedia of Great Turkish Music (Öztuna, 1990) under the titles of composer-teacher and composer networks. In final, relations of composers are measured and analyzed using maqam, tempo, and a combination of maqam and tempo similarities among them.

3.1. Social Network Analysis

In the development of social network analysis, researchers from various areas contributed. The intersection of researches occurred in a fascinating way. The main figures of this action were sociometrists, Harvard researchers in the 1930s, and the anthropologists from

Manchester. Sociometrists studied and found technical improvements with the graph theory. Researchers from Harvard studied on the relations between individuals. The anthropologists from Manchester researched the community structure. These contributions came together in Harvard in between 1960 and 1980 and formed the modern social network analysis.

Gestalt Theory of Köhler (1930) motivated some researchers in the USA who migrated from Germany to study on social and cognitive psychology. They produced lots of studies about sociometry problems and dynamics of groups. They analyzed structures of groups and information and idea flow via groups. The prominent researches of this Ecole were done by Moreno (1934) and Lewin (1936). They studied social relations between individuals. The most important innovation which had been created by Moreno (1934) was sociograms. In sociogram (Figure 2), points were used for representing individuals and lines were used to show their social relations.

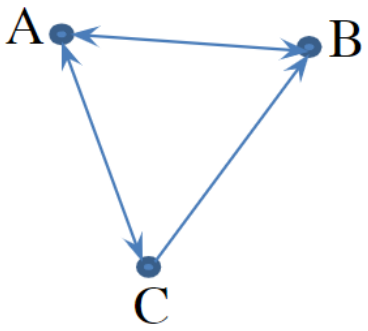


Figure 2 Sociogram

Social structures had certain and distinguishable forms (Moreno, 1934). With the help of sociograms, researchers could be able to determine the leaders and isolated persons in the network. Also, information flow and influence between individuals were visualized. The sociometric star of Moreno (1934) can be seen in Figure 3. Friendship structure of some individuals is shown in the Figure 3. Node A, node B, and node C prefers to be friend with node D. Node D is only a reciprocal to node A. As it is seen, node D is the star of this group.

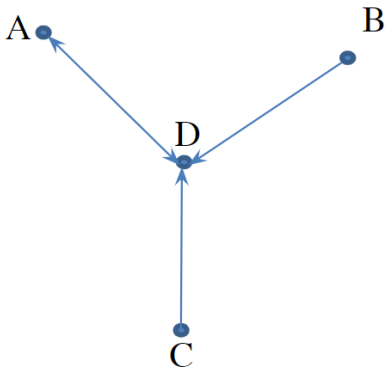


Figure 3 Sociometric Star

> The sample of a social world cannot be understood only by looking at it. But, figures in the sociograps makes social world apparent. The phenomenon of sociogram is not a simple method which is presented with schemas. It is a discovery method. Even today, there is no way to reveal structural analysis of a society as sociograms can. With sociograms, it is possible to analyze a small part of a society, and generalizing the findings into the rest of that society (Kösemihal, 1958, 72).

Lewin (1936) studied on group dynamics in a social structure. He constructed a social group in a field as it was called social space. He studied on the behaviors of this group with mathematical techniques and constructed the field theory (Lewin, 1951).

With the insights of field theory, Cartwright and Harary (1956) pioneered the applications of the graph theory (Harary and Norman, 1953; Cartwright and Zander, 1953). With the help of these mathematical studies, group dynamics theory improved in a perfect way. Meanwhile Newcomb (1953) showed there is a similar behavior and attitude to specific situations between two friends who are close to each other. This argument was generalized by Cartwright and Harary (1956) in a theory perspective. With the efforts of the researchers who worked in this field, solid models about social groups, collaboration, leadership, and power were created.

Groups were represented by points and lines by Cartwright and Harary (1956). In this way, individuals in the group were analyzed with graph theory. In this study, points represented people and lines showed their relations. Lines in the graph can have positive or negative

magnitudes. Also, arrows can be used to show the direction of the relation. The direction in a line shows the status of the relationship (positive or negative). For instance, individual A may have a positive relation with individual B. In this condition, it is understood that A likes B. In the condition of individual B have a negative relation with individual A, it shows that B hates A. With the help of this construction which shows directions and signs, Cartwright and Harary (1956) analyzed group structures individual by individual.

Above we have mentioned about directed graphs, also there are undirected graphs. In this type of graph, the relationship between node A and node B is similar to each other. This condition occurs when their attitudes are coherent in the case of the same event. In this state, direction is not taken into account while points are analyzed. Balance in an undirected graph shows the coherence among group members. In Figure 4, balanced and unbalanced group structures instances can be shown. In the graph a), it can be seen that node A and node B, node B and node C, also node A and node C have a positive relation among them. This shows that the graph is balanced because of positive relations. In the graph b), node A and node C between node B and node C have negative relations. Also, node A and node B have positive relations. It is seen that node A and node B are close to each other, but negative to node C. Therefore, this graph is balanced. In the graph c), node A and node C have positive relation; also node B and node C have positive relation. Node A and node B have negative relation. It can be said that node C could not persuade node A and node B to have a positive relation. Therefore, this graph is unbalanced. In the graph d), node A, node B, and node C have negative relations among them, therefore this graph is unbalanced.

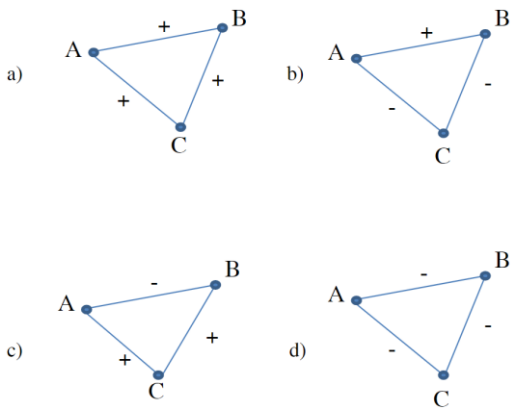


Figure 4 Balanced and Unbalanced Group Structures

Cartwright and Harary (1956) discussed that social structures, which have complexity, are constructed from simpler forms. Therefore, if these simpler forms are analyzed systematically, features of complex networks can be studied more properly. Furthermore, Cartwright and Harary (1956) showed that any balanced graph can be split into two subgroups for the analysis. Subgroups have positive relations within, but have negative relations among them. For instance, in a case when all relations in the network are positive, there is no possible way for creating subgroups. But, in more complex structures, features of these networks can be analyzed with the help of subgroup division. The importance of this subgroup division method is that helping researchers to analyze the relationship between individuals in network structures more practically.

After these improvements, two critical mathematical breakthroughs occurred in the Harvard. One of them was the improvement of algebraic models of structures with the help of set theory. The role concept in social groups was designed by using algebraic methods (White, 1963; Boyd, 1969; Lorrain and White, 1971). The other improvement was the creation of multidimensional scaling which helps to turn relations into social distances in the social space. Then, Granovetter (1973) researched strength of weak ties and Granovetter (1974) studied the subject of getting a job. He desired to understand people get a job with what kind of ties which are strong or weak.

Graph theory is simply a study of graphs. Graphs are used to model relationships between objects. Nodes (points) and edges (lines) are in the graphs. As previously mentioned, sociogram is also a graph. Lines define the relationship and it can be directed (from one individual to another) or undirected. In Figure 5, adjacency matrix and its corresponded undirected graph can be seen. It can be said that node A is adjacent to node B, C, and D since there is a line between them. Degree term is used for determining the neighbors of a point. For example, in Figure 5, node A has a degree of 3, node B has a degree of 1, and node C and D have degree of 2. Distance term, which is also known as geodesic distance, is used to define the number of edges in the shortest path between two nodes. In Figure 5, the distance of BD path is 2 and the distance of AD is 1. In Figure 6, a directed graph and its matrix example can be seen. There are indegree and outdegree terms in directed graphs. Indegree of a node corresponds to the lines towards to it from the other nodes. On the opposite, outdegree of a node means that the lines go to the other nodes. In Figure 6, node

A and node B have indegree of 2. Node C has indegree of 1. Node A and node C have outdegree of 2. Node B has outdegree of 1. Another important term we have to mention is density. Density is calculated as the proportion of the number of edges and the maximum possible number of edges. Equations of density with graph type are:

D= 2*e/(n* (n-1)), e=edge number, n= node number, for undirected graphs (1)

D= e/(n* (n-1)), e=edge number, n= node number, for directed graph (2)

In Figure 5, density is 0.67. In Figure 6, density is 0.5. Density is important to measure the effectiveness of the network.

	A	B	C	D
A	-	1	1	1
B	1	-	0	0
C	1	0	-	1
D	1	0	1	-

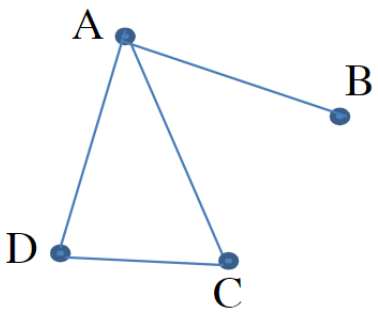


Figure 5 Adjacency Matrix and Its Corresponded Undirected Graph

	A	B	C
A	-	1	1
B	1	-	0
C	1	1	-

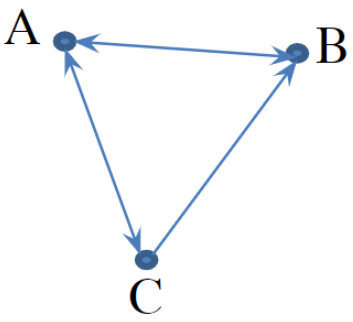
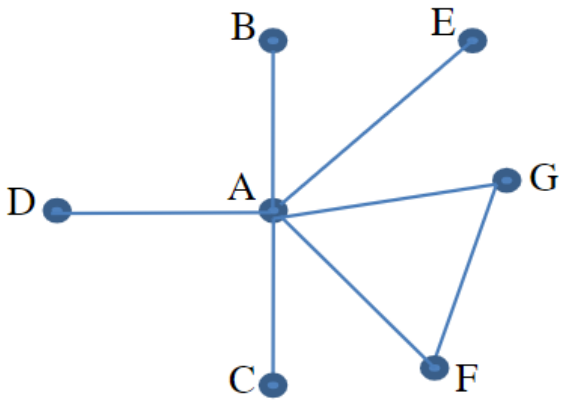


Figure 6 Directed Graph and Its Matrix

Centrality between individuals in social networks was an important area to be researched by the researchers. The Sociometric star concept of Moreno (1934) is the origin of centrality. Then, Bavelas (1950) studied centrality on individuals. The main importance of

centrality is that it shows the most influential node in the social structure. By this way, central figure of the social structure can be determined for the analysis.

Degree term is used firstly by Shaw (1954) as an indicator for point centrality. Subsequently, Freeman (1978) had argued the point (degree) centrality and graph centrality with his beneficial study. Degree of a node is calculated as the sum of the number of edges upon that node. This calculation is valid for undirected graphs. For directed graphs, there are indegree and outdegree. Indegree of a node is calculated as the sum of the number of incoming edges. On the opposite, outdegree of a node is calculated as the sum of the number of outgoing edges. Freeman (1978) suggested that the calculation of degree centrality is done with the proportion of the degree of a node and the number of other nodes in the graph. For instance, in a degree of 10 in a graph of 50 points, degree centrality is 0.2. With a degree of 5 in a graph of 10 points, degree of centrality is 0.5. Figure 7 shows a degree centrality example of a graph.



	A	B,C,D,E	G,F
Degree	6	1	2
Degree Centrality	1	0.17	0.33

Figure 7 Degree Centrality of a Graph

Freeman (1978) also studied closeness centrality. As previously mentioned, distance between nodes does not affect the calculation of degree centrality. Closeness centrality of a point is the average length of the shortest path between the point and the other points in the

graph. Freeman (1978) also proposed the concept of betweenness centrality which is to find out how many times a point acts like a bridge in the shortest path between two other points. This work showed that a node is dependent to another node, if another node uses the lines through that node in the connection with third node. Burt (1992) studied in his "Structural Holes" work that there is a structural hole if a node is connected to another node with the help of the third node. In this event, third node is a broker (Burt, 1992). In Figure 7, D node is dependent to A node to connect to other nodes in the graph.

Bonacich (1972) proposed eigenvector centrality. It is used to present the importance of a node in the graph. In the method, it is shown that when a node is connected to a central node, the centrality of the node and its connection arises. For instance, an individual is not powerful person, but his/her friend has great power in the social structure. With this friendship, powerful person can help the person who is not powerful, and weak person and his connections can be more powerful.

Milgram (1967) conducted the small-world problem. In the research, Milgram (1967) proposed that a message can be delivered from one node to another in six steps at maximum. Watts and Strogatz (1998) proved the six degrees are valid for a complex network.

3.2. Enderun and Mevleviyye

In this section, the importance of Enderun and Mevleviyye is mentioned considering their functions.

> Enderun is the most important educational institution after medresa since 15th century. It is established to provide manpower resources in the Ottoman Empire. The ideology and thoughts of Ottoman is lectured in Enderun. Also, the place of Enderun is extremely solid in the operations of the instutions of the government (İpşirli, 2019, para. 1).

As it is mentioned above, the main function of Enderun was to educate talented people who will be the headman in the governmental operations.

> Mevleviyye is a Turkish order founded by Sultan Veled (son of Mevlana). Mevlevihanes were one of the most important center of Turkish culture. Persian philology, Mesnevi, mysticism, and musical education was in the center of teaching. Ethics, decency, and religion sciences were also lectured in Mevlevihanes (Öztuna, 1990, p. 54).

Mevlevis performed their dhikr in the musical ceremony which is called Sama, by whirling.

In this study, we are interested in the musical part of Enderun and Mevleviyye. We must indicate that the ideology and function of Enderun and Mevleviyye is beyond the musical education undoubtfully.

3.3. Music Education in Classical Turkish Music

In classical Turkish music, as previously mentioned, composers learn from their teachers with the Meşk system. The Meşk in word meaning is practicing. In the Meşk system, a piece of music is performed by a master little by little with his student until a student learns the whole piece flawlessly. When musical notation was not used, the Meşk was highly important.

Places of education were houses of some masters, Mevlevihanes, other lodges, and Enderun etc. Some pieces of music had remained unforgotten with the help of the composers who transferred them through minds. Most of the work of music came today with this way. It is noted in the Öztuna (1990) that when the first time musical notation had started to be used, most of the musicians had refused to use and underrated it and therefore thousands of our musical pieces had been forgotten naturally. After the musical notation had started to be used, the importance of the Meşk system had decreased, but the notation with nuance did not expanse and therefore the Meşk is still important for transferring emotion and style; for disclaiming the Meşk system, musical notation has to be highly carefully organized considering nuance and accurate (Öztuna, 1990).

> Enderun is the most important place for music education. Religious and non-religious music was taught in Enderun. The institute had high level musical education that can be compared to Enderun were Mevlevihanes. Even the smallest Mevlevihanes had musical organizations and it is remarkable that not only Mevlevi music were taught, but also religious and non-religious music, and instruments (Öztuna, 1990, p. 450).

In the institutes which were connected to the Mosques, only religious music was taught. There was not teaching of playing an instrument and non-religious music. It is also mentioned in Öztuna (1990) that famous willing musicians had accepted students in their houses, and some of them taught students one by one, some of them as a group, besides this tradition is still applied in Turkey and in the West.

> One place of musical education that was given was guilds. Singers and instrument players who were not belonged to the Palace, Mosque, and Lodges were belonged to the unions. Mehterhane in the palace were a place for military music education. In 1826, Mehterhane were done away with the order of the Sultan, and Muzıkay-ı Hümâyûn were opened. Darülelhan had been opened to function as a state conservatory by the Ministry of Education. After 1908, lots of music schools were opened in the last days of the empire and the first days of the republic and most of them were opened by the musicians who were confident for their reputations (Öztuna, 1990, p. 451).

Terakki-i Musiki was opened by Ali Salahi Bey, Fahri Kopuz, Kanuni Nazım Bey, and Hanende Aziz Bey; Muallim İsmail Hakkı Bey and İzzeddin Hümayi Elçioğlu opened Darül Musiki-i Osmani; Darül Musiki belonged to Kazım Uz; Darül Feyzı Musiki belonged to Edhem Bey; Şark Musikii Cemiyeti were built by Ali Rifat Çağatay, Levon Hancıyan, and Bestenigar Ziya Bey; one of the most important schools which is Darüt Talimi Musiki were opened by Fahri Kopuz; Meşkhouse of Bolahenk Nuri Bey was popular in that time (Öztuna, 1990).

3.4. Maqam, Tempo, and Forms

Maqam is the use of scales within the frame of certain rules. It includes mode and tonality. Mode in the Western music is a musical scale type which contains a specific set of melodic behavior. Tonality is the arrangement of chords in a musical work. Tempo is the measure which is formed with the certain rhythms. In the treatise on music of Demetrius Cantemir in 1700 it is given that a melody must have a rhythmic pattern and the tempos are the scales of music (Hammarlund, Olsson, and Ozdalga, 2004).

In classical Turkish music, composers composed their music considering choosing individually maqam and tempo within the frame of a musical form. Musical form is the framework of a musical composition. Musical forms are divided into groups as instrumental music that are Peşrev, Taksim, Medhal, Saz Semaisi, Oyun Havası, and Aranağme and vocal music that are religious and non-religious music. Religious musics are Mevlevi Ayini, Na't, Durak, Miraciye, İlahi, Tevşih, Şugûl, Ezan, Tekbir, Temcid, Tesbih, Salat and Salam, Münacaat, and Mevlit. Non-religious musics are Kâr, Beste, Semai, Gazel, Şarkı, Türkü, and Köçekçe.

As previously detailed, the Meşk system is the most important education style for composers that absorb knowledge to create unique music that is done face to face in classical Turkish music. In the education process, maqam and tempo are learned from the teacher directly without learning from notes. Therefore, we assume that the student can directly be influenced by his teacher throughout the Meşk system.

3.5. Data in the Research

Data that are used in this research are gathered from Oktar (2009) and Encyclopedia of Great Turkish Music (Öztuna, 1990). Archive in the website of Oktar (2009) depends on TRT (Institute of Radio and Television of Turkey) sources. These data include 20200 works, with their 1617 composers, and used maqam and tempo. This amount of data was needed to be decreased for gathering better visualization and making better interpretation. Then, firstly average work of the composers was calculated as 11,98. Then, it is decided to use data of a composer who has at least 12 works. 303 composers left in the wake of this

cut with their 16932 works. Still network in the Gephi was not clear for interpretation. Also, we wanted to focus on the periods which are highly important in the development of classical Turkish music. Therefore, it is decided to consider date of birth. Composers, who were born after 1901, are eliminated from the data. In the result of this action, 99 unique composers are remained for network analysis. The number of 99 was sensible and excellent for significant visualization and analysis. Also, 181 unique maqams and 136 unique tempos are used by the composers in our data which are used for the analysis.

As a method in this work, common network analysis techniques are used to create meaningful results that are interpretable by considering efficiency in the specific circumstances. These techniques are Degree Centrality, Eigenvector Centrality, Betweenness Centrality, Average Weighted Degree, Modularity, and PageRank. In the study, Python Software is used to measure maqam, tempo, and maqam and tempo similarities among composers and Gephi Software is used to illustrate and visualize data.

Firstly, in the methodology part, periods, locations, schools, workplaces, and nationalities of the composers are revealed. Then, the relations of composers are measured via information that includes composer-teacher network and composer network, from the Encyclopedia of Great Turkish Music (Öztuna, 1990). Then, the relations of composers are measured via maqam, tempo, and the combination of maqam and tempo similarity to reveal influences on each other. In the processes of the finding of maqam and tempo similarity among composers, cosine similarity is used as a measure. In cosine similarity, maqam and tempo of the composers are thought as words of bags. This means the number of use of maqams and tempos which are used by composers are taken into consideration in the similarity calculation process. Maqam and tempo are considered important since these are delivered from teacher to student with the Meşk system that lies at the core of Education in classical Turkish music. In the analysis, comparison and interpretation is made between information that is extracted from the encyclopedia (Öztuna, 1990) and values are gathered from the calculation of maqam and tempo similarity.

3.6. Periods of the Composers

In the Table 1, the percentage of the born date of the composers with centuries can be seen. We can say that, composers who born in the 19th century is highly important for us. Since the nature of the Meşk system, we are not surprised. Because we saw in our research that most of the work of the composers had been lost in time since composers did refuse to use musical notation or it did not exist a musical notation system.

Composer characteristics	Percentage (%)
Percentage born in 14th Century	1%
Percentage born in 17th Century	5%
Percentage born in 18th Century	15%
Percentage born in 19th Century	79%

Table 1 The Percentage of the Born Date of the Composers

3.7. Locations of Composers

In this part, locations of composers are analyzed with the help of information which is gathered from the encyclopedia (Öztuna, 1990). Firstly, degree centrality and eigenvector centrality methods are applied. In the Table 2, the measures can be seen.

Rank	City	In-Degree Centrality	Eigenvector Centrality
1	Istanbul	0,7826	1,0
2	Thessaloniki	0,0261	0,0333
3	Baghdad	0,0174	0,0222
3	Cairo	0,0174	0,0222
4	Tabriz	0,0087	0,0111
4	Samarkand	0,0087	0,0111
4	Larissa	0,0087	0,0111
4	Amasya	0,0087	0,0111
4	Bursa	0,0087	0,0111
4	Crete	0,0087	0,0111
4	Paris	0,0087	0,0111
4	Aleppo	0,0087	0,0111
4	Damascus	0,0087	0,0111
4	Medina	0,0087	0,0111
4	Izmir	0,0087	0,0111
4	Lesbos	0,0087	0,0111
4	Drama	0,0087	0,0111

Table 2 In-Degree and Eigenvector Centrality of the Composers with Locations

Then, Modularity Algorithm (Blondel, et al., 2008) is applied to location of composers. Afterwards, Yifan Hu Proportional and Label Adjust metrics are applied respectively. Modularity is measured as 0,301. Clustered communities in the center can be seen in Figure 8.

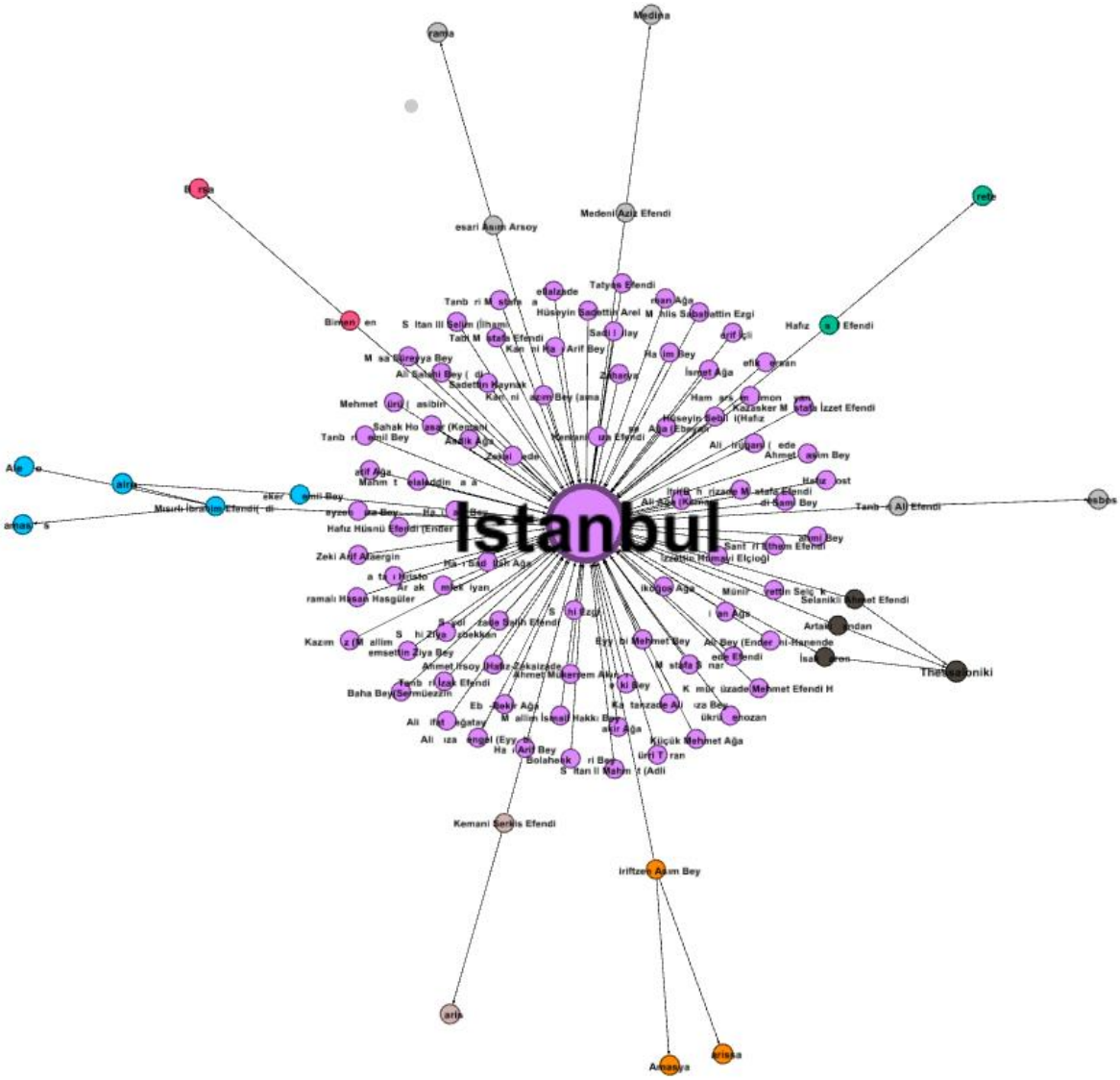


Figure 8 Modularity of the Composers with Locations

Figure 8 proves that; Istanbul is the most important location for classical Turkish music by far. In the Figure 8, it can be seen that most of the composers had only studied and worked in Istanbul. Some of them were born in a different city, but later they had gone to Istanbul. The reason of this situation is study and work opportunities of Istanbul. As we mentioned before, Enderun, Muzıkay-ı Hümâyûn, most important Mevlevihanes, Darüşşafaka, Darül

Feyzı Musiki, and Darül Musikii Osmani were in Istanbul. Music labor was highly popular with the supports of the Sultans. When the creativity and productivity of the composers are considered, it is surely beyond doubt that the capital of classical Turkish music was Istanbul.

3.8. School of Composers

In this part, schools of composers are analyzed with the help of information which is gathered from the encyclopedia (Öztuna, 1990). Firstly, degree centrality, eigenvector centrality and PageRank methods are applied. In the Table 3, the measures can be seen.

Rank	School	In-Degree Centrality	Eigenvector Centrality	PageRank
1	Enderun	0,1552	1	0,1207
2	Muzıkay-ı Hümâyûn	0,0431	0,2778	0,0389
3	Mevlevihane	0,0345	0,2222	0,0326
4	Darüşşafaka	0,0172	0,1111	0,0200
5	Armenian Church	0,0086	0,5556	0,0137
5	Darül Feyzı Musiki	0,0086	0,5556	0,0137
5	Darül Musikii Osmani	0,0086	0,5556	0,0137
5	Madresa	0,0086	0,5556	0,0137

Table 3 In-Degree, Eigenvector Centrality, and PageRank of the Composers with Schools

Then, Modularity Algorithm (Blondel, et al., 2008) is applied to schools of composers. After, Yifan Hu and Label Adjust metrics are applied respectively. Modularity is measured as 0,657. Communities clustered partly. Clustered communities can be seen in Figure 9, Figure 10, Figure 11, and Figure 12 respectively.

Table 3 proves that, Enderun is the most prominent musical school. This result is not surprising since Enderun was the most popular place for learning classical Turkish music between 1453 and 1826 (Öztuna, 1990). After 1826, Enderun had been weakened, then Muzıkay-ı Hümâyûn had taken the place of Enderun. As it is seen in Table 3, Muzıkay-ı Hümâyûn ranks as 2. When Figure 9, 10, 11, and 12 is analyzed, it can be clarified that Enderun and Mevlevihane were popular among older composers when the active years of composers are taken into consideration. Modern composers like Hacı Arif Bey, Suphi Ezgi, and Muallim İsmail Hakkı Bey were trained in Muzıkay-ı Hümâyûn. It is important

to indicate that classical music had come to the Ottoman Empire with Muzıkay-ı Hümâyûn. Many Turks learned to play western instruments in Muzıkay-ı Hümâyûn (Öztuna, 1990). Itri (Buhurizade Mustafa Efendi) and Dede Efendi, who are two of the most important composers of classical Turkish music, were trained in Mevlevihane.

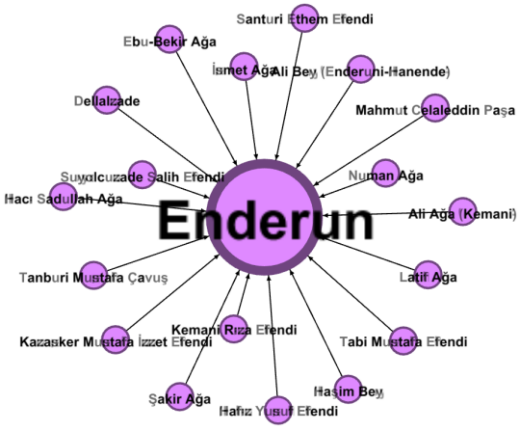


Figure 9 The Composers in Enderun

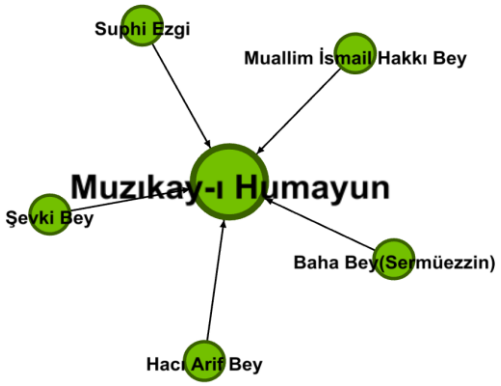


Figure 10 The Composers in Muzıkay-ı Hümâyûn

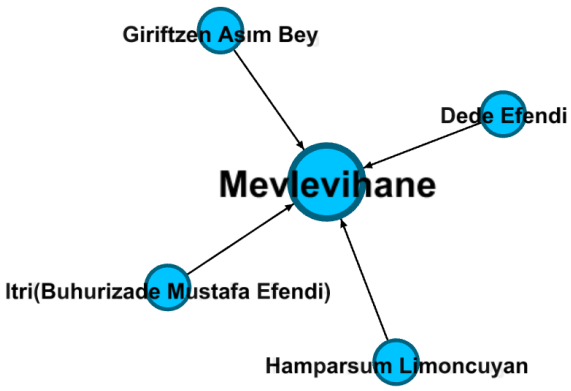


Figure 11 The Composers in Mevlevihane

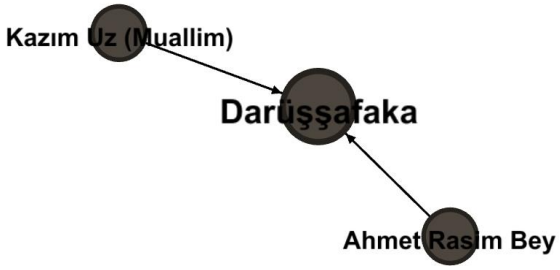


Figure 12 The Composers in Darüşşafaka

3.9. Workplaces of Composers

In this part, workplaces of composers are analyzed with the help of information which is gathered from the encyclopedia (Öztuna, 1990). Firstly, degree centrality and eigenvector centrality methods are applied. In the Table 4, the measures can be seen.

Rank	Workplace	In-Degree Centrality	Eigenvector Centrality
1	Enderun	0,1478	1.0
2	Palace Muezzin	0,0609	0,4118
2	Darül Musikii Osmani	0,0609	0,4118
2	Muzıkay-ı Hümâyûn	0,0609	0,4118
3	Mevlevihane	0,0522	0,3529
4	Haremi Humayun	0,0348	0,2353
5	Dervish Lodge	0,0261	0,1765
5	Conservatoire of Istanbul	0,0261	0,1765
6	Şark Musiki Cemiyeti	0,0174	0,1176
6	Darülelhan	0,0174	0,1176
6	Palace of Cairo	0,0174	0,1176
7	Terakkii Musiki	0,0087	0,0588
7	Meskhouse	0,0087	0,0588
7	Darüt Talimi Musiki	0,0087	0,0588
7	Darüşşafaka	0,0087	0,0588
7	Church	0,0087	0,0588

Table 4 In-Degree and Eigenvector Centrality of the Composers with Workplaces

Then, PageRank method is applied. Table 5 shows PageRank values.

Rank	Workplace	PageRank	Rank	Workplace	PageRank
1	Enderun	0,0869	9	Darulelhan	0,0147
2	Darul Musikii Osmani	0,0357	10	Sark Musiki Cemiyeti	0,0138
3	Palace Muezzin	0,0311	11	Terakkii Musiki	0,0119
4	Mevlevihane	0,0302	11	Meskhouse	0,0119
5	Muzıkayi Humayun	0,0284	11	Church	0,0119
6	Dervish Lodge	0,0202	12	Palace of Cairo	0,0110
7	Haremi Humayun	0,0193	13	Darut Talimi Musiki	0,0092
8	Conservatoire of Istanbul	0,0165	14	Darussafaka	0,0083

Table 5 PageRank of the Composers with Workplaces

In final, Modularity Algorithm (Blondel, et al., 2008) is applied to workplaces of composers. After, Yifan Hu and Label Adjust metrics are applied respectively. Modularity is measured as 0,674. Most of the communities clustered in center. Clustered communities can be seen in Figure 13.

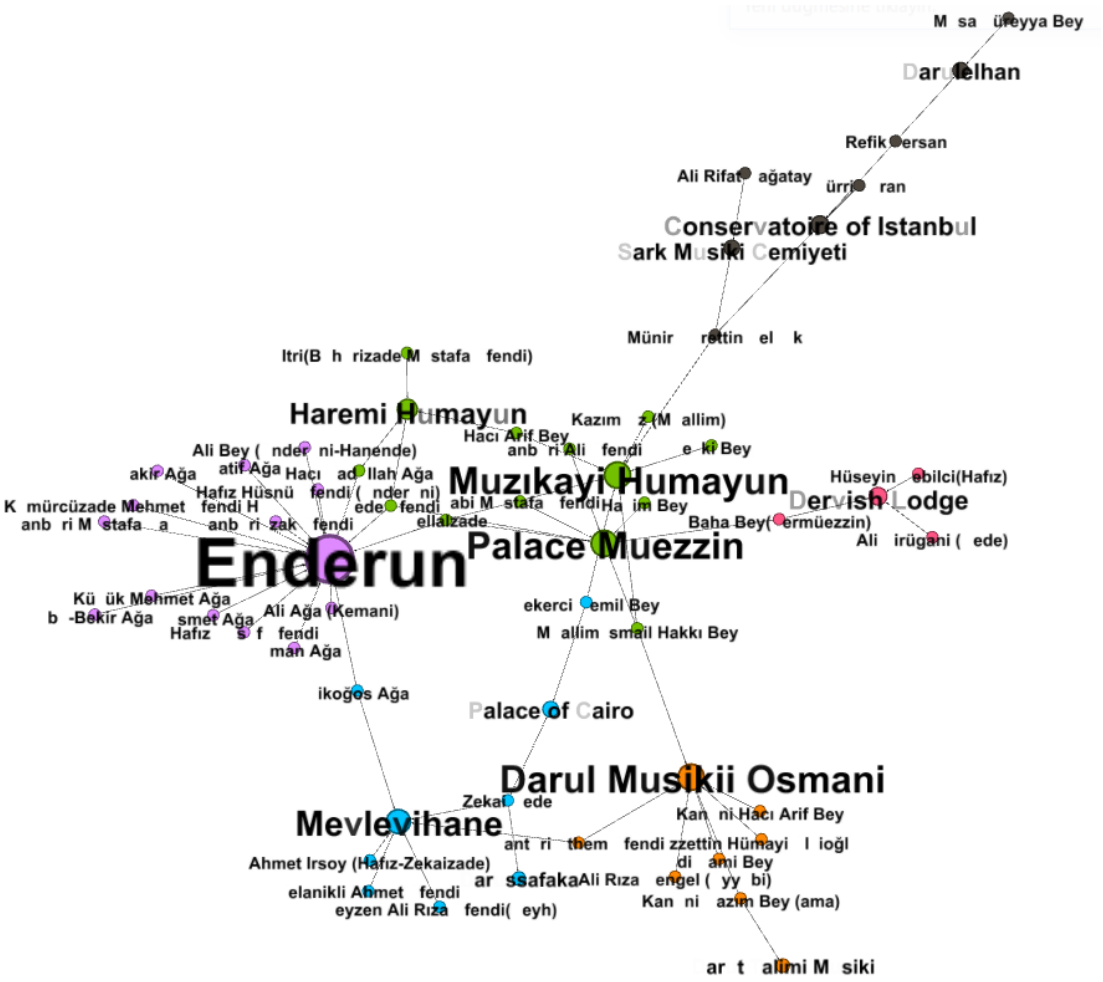


Figure 13 Modularity of the Composers with Workplaces

Table 4 shows that, Enderun is the most favored workplace. Then, Palace Muezzin, Darul Musikii Osmani, and Muzıkay-ı Hümâyûn accompany. Some of the composers, who is not seen in Figure 13, worked in the music market, others had their own professions.

3.10. Nationalities of Composers

In this part, nationalities of composers are analyzed with the help of information which is gathered from the encyclopedia (Öztuna, 1990). Firstly, degree centrality, eigenvector centrality, and PageRank methods are applied. In the Table 6, the measures can be seen.

Rank	Nationality	In-Degree Centrality	Eigenvector Centrality	PageRank
1	Turks	0,7353	1,0	0,3520
2	Armenians	0,1078	0,1467	0,0563
3	Jews	0,0392	0,0533	0,0239
4	Greeks	0,0294	0,0400	0,0193
5	Gypsies	0,0098	0,0133	0,0101

Table 6 In-Degree, Eigenvector Centrality, and PageRank of the Composers with Nationalities

Then, Modularity Algorithm (Blondel, et al., 2008) is applied to the nationalities of composers. After, Yifan Hu and Label Adjust metrics are applied respectively. Modularity is measured as 0,347. Communities clustered partly. Clustered communities can be seen in Figure 14, Figure 15, Figure 16, and Figure 17 respectively.

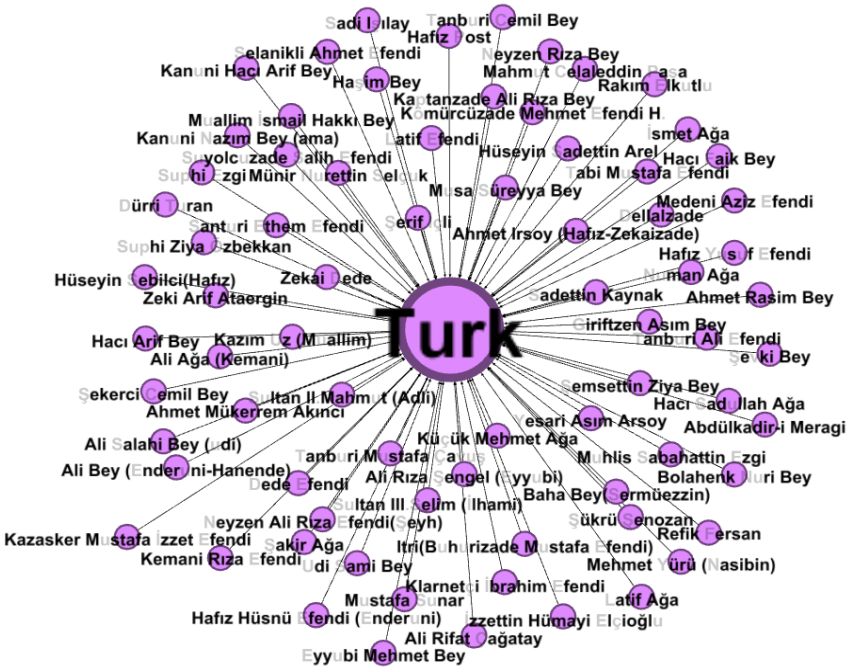


Figure 14 Turk Composers

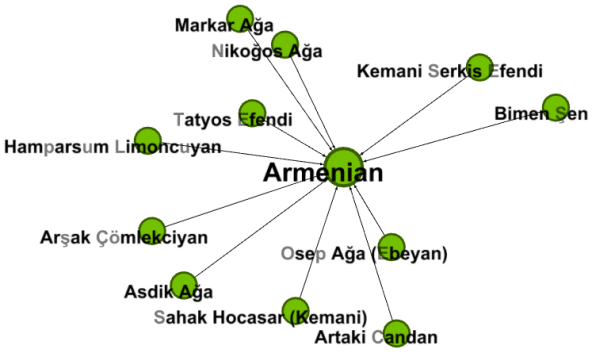


Figure 15 Armenian Composers

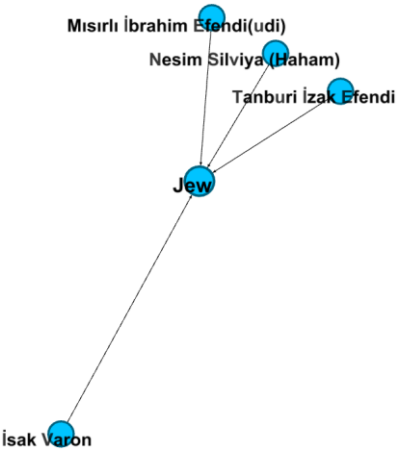


Figure 16 Jewish Composers

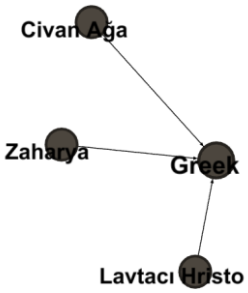


Figure 17 Greek Composers

Figure 14 shows that most of the composers are Turks in classical Turkish music. It should be indicated that there is a considerable amount of Armenian composers. Also, there are Jewish, Greek, and Gipsy composers.

3.11. Measuring Relations of Composers via Information from the Encyclopedia of Great Turkish Music

In this part, firstly, composer-teacher and composer network frameworks are studied with information gathered from the Encyclopedia of Great Turkish Music (Öztuna, 1990). Subsequently, maqam, tempo, and maqam and tempo similarity among composers are measured with cosine similarity. Lastly, each composer is analyzed in detail with their similarities among them in the maqam and tempo similarity part.

3.11.1. Composer-Teacher Network

Composer-teacher relationships are revealed by the information which is gathered from the encyclopedia (Öztuna, 1990). In this part, firstly degree centrality method is applied. The score is normalized between 0 and 1. Then, Yifan Hu and Label Adjust metrics are applied. The result can be seen in Figure 18, Figure 19 and Table 7.

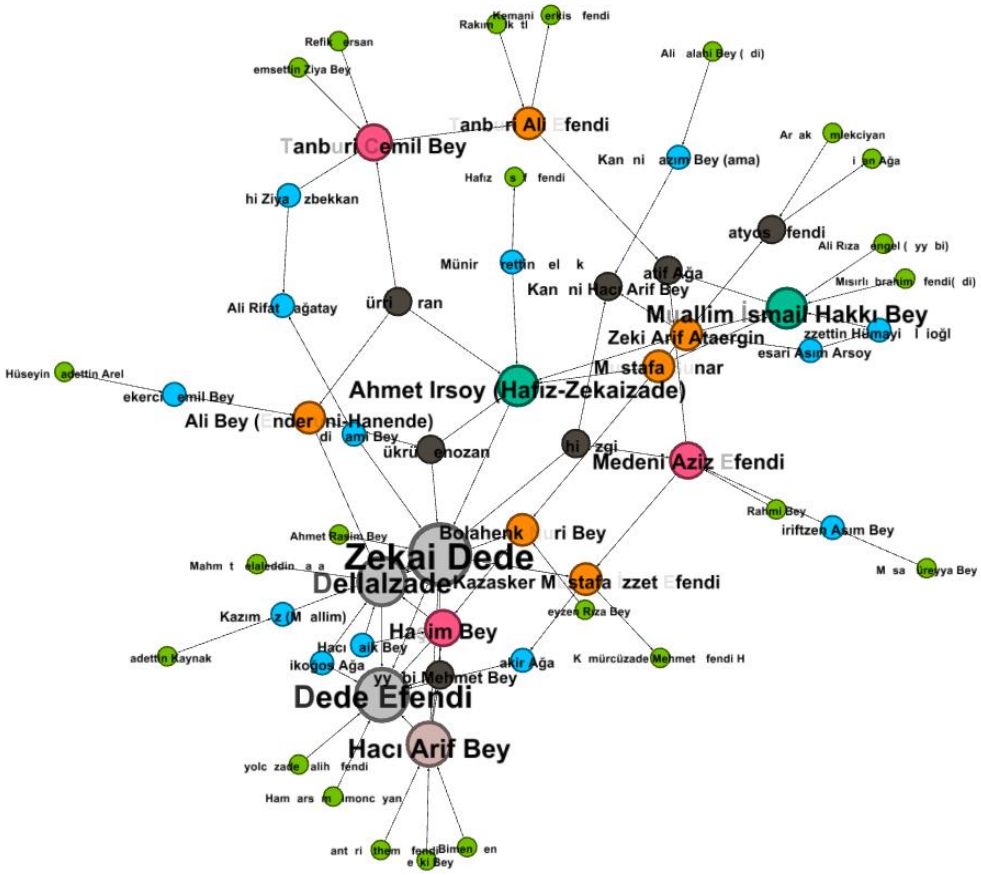


Figure 18 Degree Centrality of Composer-Teacher Network in centered (Isolates are removed)

Figure 19 Degree Centrality of Isolated Composer-Teacher Network away from the center

As it is seen in Table 7, Zekai Dede is the most central person. We have to mention that Zekai Dede is the student of Dede Efendi, Dellalzade, and Kazasker Mustafa İzzet Efendi and is the teacher of Ahmet Irsoy (Hafız-Zekaizade), Hacı Arif Bey, Suphi Ezgi, and Şükrü

Şenozan. Results in Table 7 prove his solid networks with prominent composers. In rank 2, Dede Efendi is located. It is known that he is the teacher of Zekai Dede, Dellalzade, Hacı Arif Bey, and Haşim Bey. When the positions of these composers are examined, it is clearly understood that the position of Dede Efendi is not surprising. Leading composer Dellalzade accompanies as rank 3. As previously mentioned, Dellalzade is the student of Dede Efendi. Also, he is also the teacher of Zekai Dede, Haşim Bey, Bolahenk Nuri bey, and Ali Bey (Enderuni-Hanende). Hacı Arif Bey, who is the prominent composer of song structure, is located in rank 4. He is the student of Zekai Dede, Dede Efendi, and Haşim Bey. Ahmet Irsoy (Hafız-ı Zekaizade) and Muallim İsmail Hakkı Bey shares the place of rank 5. Ahmet Irsoy is the son of Zekai Dede. He learned the music from his father. He is the teacher of Mustafa Sunar, Zeki Arif Ataergin, Dürri Turan, and Şükrü Şenozan. Muallim İsmail Hakkı Bey is the student of Latif Ağa and the teacher of Mustafa Sunar and Zeki Arif Ataergin. Rank 6 holds Haşim Bey, Medeni Aziz Efendi, and Tanburi Cemil Bey. Haşim Bey is the teacher of Hacı Arif Bey and Bolahenk Nuri Bey. Medeni Aziz Efendi is the student of Kazasker Mustafa İzzet Efendi and Latif Ağa, also he is the teacher of Suphi Ezgi. Tanburi Cemil Bey is the teacher of Dürri Turan.

Rank	Composer	Degree Centrality	Rank	Composer	Degree Centrality
1	Zekai Dede	0,112	7	Kazasker Mustafa İzzet Efendi	0,041
2	Dede Efendi	0,092	7	Ali Bey (Enderuni-Hanende)	0,041
3	Dellalzade	0,082	7	Mustafa Sunar	0,041
4	Hacı Arif Bey	0,071	7	Tanburi Ali Efendi	0,041
5	Ahmet Irsoy (Hafız-Zekaizade)	0,061	7	Zeki Arif Ataergin	0,041
5	Muallim İsmail Hakkı Bey	0,061	8	Dürri Turan	0,031
6	Haşim Bey	0,051	8	Kanuni Hacı Arif Bey	0,031
6	Medeni Aziz Efendi	0,051	8	Latif Ağa	0,031
6	Tanburi Cemil Bey	0,051	8	Suphi Ezgi	0,031
7	Bolahenk Nuri Bey	0,041	8	Şükrü Şenozan	0,031

Table 7 Ranked Twenty Composers with Degree Centrality in Composer-Teacher Network

For understanding more efficiently, eigenvector centrality method is applied. As previously mentioned, this method measures the importance of a node by taking its connection into consideration. In Table 8, Dede Efendi is the lead composer by far. This result proves that Dede Efendi created a great impact on his students who holds extremely important locations in the network structure. Dellalzade accompanies as rank 2. It is known that Dellalzade is also an important teacher. Lots of composers had taken advantage of his

training. Results show that he also created an impact on his students. Kazasker Mustafa İzzet Efendi is in rank 3 since he had taught Zekai Dede. In rank 4, Eyyubi Mehmet Bey is placed. His rank in the Table 8 can seem surprising, but it is not. Actually, he is the student of Dede Efendi. He was not on the Table 7, since he connected to composers in numerous classes, but important persons. He is one of the teachers of Zekai Dede and Hacı Arif Bey. The position of Eyyubi Mehmet Bey comes from his important connections.

Rank	Composer	Eigenvector Centrality	Rank	Composer	Eigenvector Centrality
1	Dede Efendi	1,000	10	Tanburi Ali Efendi	0,062
2	Dellalzade	0,391	11	Muallim İsmail Hakkı Bey	0,059
3	Kazasker Mustafa İzzet Efendi	0,244	12	Ahmet Irsoy (Hafız-Zekaizade)	0,046
4	Eyyubi Mehmet Bey	0,234	13	Kanuni Hacı Arif Bey	0,045
5	Latif Ağa	0,214	14	Medeni Aziz Efendi	0,033
6	Şakir Ağa	0,196	14	Ali Bey (Enderuni-Hanende)	0,033
6	Kömürcüzade Mehmet Efendi H.	0,196	15	Civan Ağa	0,031
7	Zekai Dede	0,167	16	Tanburi Cemil Bey	0,028
8	Haşim Bey	0,081	17	Hacı Arif Bey	0,021
9	Kemani Serkis Efendi	0,073	18	Tanburi İzak Efendi	0,019

Table 8 Ranked Twenty Composers with Eigenvector Centrality in Composer-Teacher Network

In final, the betweenness centrality method is applied. Hereinbefore, this method measures a node who sits on the shortest paths that connects with others. Table 9 shows that Zekai Dede is the prominent composer by far. We can deduce that he has the ability to control the flow of information in the network. Kazasker Mustafa İzzet Efendi also ranks highly since his connection with Zekai Dede. Ahmet Irsoy (Hafız-Zekaizade) is in the third position since his Zekai Dede and his other connections.

Rank	Composer	Betweenness Centrality	Rank	Composer	Betweenness Centrality
1	Zekai Dede	0,0085	9	Muallim İsmail Hakkı Bey	0,0006
2	Kazasker Mustafa İzzet Efendi	0,0048	9	Ali Bey (Enderuni-Hanende)	0,0006
3	Ahmet Irsoy (Hafız-Zekaizade)	0,0033	9	Giriftzen Asım Bey	0,0006
4	Hacı Arif Bey	0,0025	9	Bolahenk Nuri Bey	0,0006
5	Medeni Aziz Efendi	0,0018	10	Şakir Ağa	0,0005
6	Tanburi Ali Efendi	0,0013	11	Haşim Bey	0,0004
6	Tanburi Cemil Bey	0,0013	12	Şekerci Cemil Bey	0,0003
7	Zeki Arif Ataergin	0,0010	13	Tatyos Efendi	0,0002
8	Kazım Uz (Muallim)	0,0007	14	İzzettin Hümayi Elçioğlu	0,0001
8	Dellalzade	0,0007	14	Kanuni Nazım Bey (ama)	0,0001

Table 9 Ranked Twenty Composers with Betweenness Centrality in Composer-Teacher Network

In final, Modularity Algorithm (Blondel, et al., 2008) is applied to composer-teacher network. Louvain method is used in Gephi for calculating modularity. Modularity algorithm measures how well a network splits into modular communities. Then, Yifan Hu Proportional and Label Adjust metrics are applied respectively. Modularity is measured as 0,612. Number of Communities was calculated as 41. The size distribution graph can be seen in Figure 20. Because communities with low member moved away from the center, six communities clustered in the core of the network. Communities that clustered in the center can be seen in Figure 20. Then, PageRank Algorithm (Brin and Page, 1998) is applied to the network with Epsilon = 0.001 and Probability = 0.85 values. The size of the nodes shows the magnitude of PageRank values. As it can be observed in the Figure 20, Dede Efendi, Latif Ağa, Zekai Dede, Muallim İsmail Hakkı Bey, Tanburi Cemil Bey, and Civan Ağa have the highest PageRank values in the six clustered communities respectively. This means these nodes are the most important nodes in their clusters. Also, Figure 21 shows composers away from the center in the result of modularity algorithm. Top 20 PageRank values can be seen in Table 10.

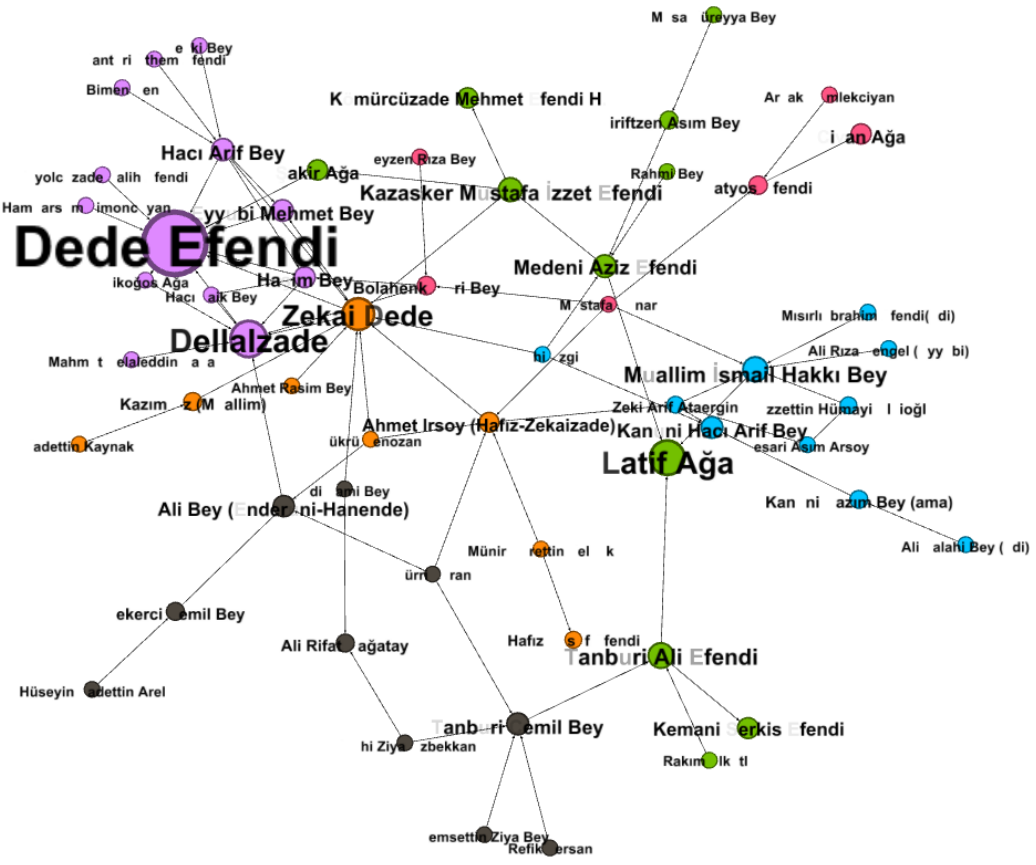


Figure 20 Modularity of Composer-Teacher Network in centered (Isolates are removed)



Figure 21 Modularity of Composer-Teacher Network away from the center

Rank	Composer	PageRank	Rank	Composer	PageRank
1	Dede Efendi	0,104	10	Eyyubi Mehmet Bey	0,018
2	Dellalzade	0,048	11	Kanuni Hacı Arif Bey	0,017
3	Latif Ağa	0,045	11	Ali Bey (Enderuni-Hanende)	0,017
4	Zekai Dede	0,039	12	Haşim Bey	0,016
5	Tanburi Ali Efendi	0,025	12	Kemani Serkis Efendi	0,016
6	Muallim İsmail Hakkı Bey	0,024	13	Kömürcüzade Mehmet Efendi H.	0,015
7	Kazasker Mustafa İzzet Efendi	0,022	13	Şakir Ağa	0,015
8	Medeni Aziz Efendi	0,020	13	Civan Ağa	0,015
9	Hacı Arif Bey	0,019	14	Hafız Post	0,014
10	Tanburi Cemil Bey	0,018	14	Selanikli Ahmet Efendi	0,014

Table 10 Ranked Twenty Composers with PageRank in Composer-Teacher Network

Table 10 shows that Dede Efendi is the most central composer by far. PageRank works like when the lines are followed randomly in the network, if the arrival of to the node is highly possible, the importance of the node increases. The position of Dede Efendi in Table 10 is not surprising because of his students more in number. Dellalzade ranks as 2. He also had lots of students. In third rank, Latif Ağa locates. He is the teacher of Tanburi Ali Efendi, Muallim İsmail Hakkı Bey and Medeni Aziz Efendi. His important position in Table 10 can be clarified as outnumbering connections of his students. For example, Muallim İsmail Hakkı Bey is the teacher of 5 people in our data. Other connections of Latif Ağa also have pretty many connections. Figure 20 shows a great perspective for us to see the big picture.

3.11.2. Composer Network

Composer networks are revealed by the information which is gathered from the encyclopedia (Öztuna, 1990). In this part, firstly degree centrality method is applied. The result can be seen in Figure 22 and Figure 23.

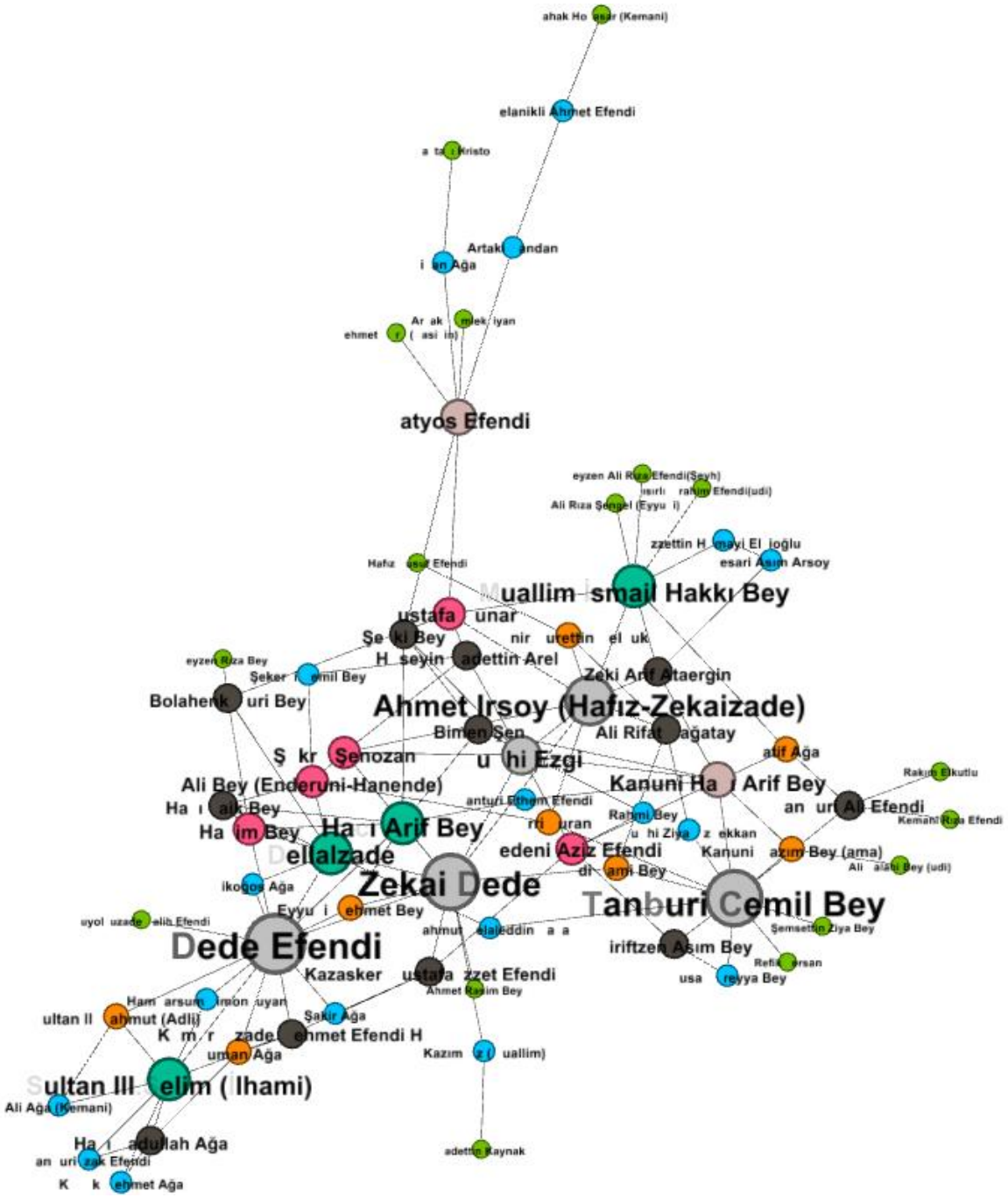


Figure 22 Degree Centrality of Composer Network in centered (Isolates are removed)

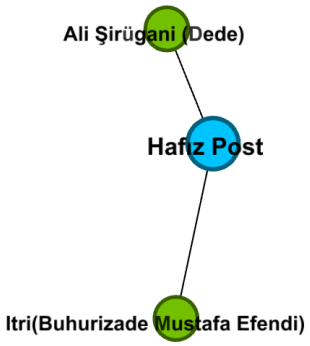


Figure 23 Degree Centrality of Isolated Composer Network away from the center

Rank	Composer	Degree Centrality	Rank	Composer	Degree Centrality
1	Dede Efendi	0,133	6	Tatyos Efendi	0,061
2	Tanburi Cemil Bey	0,122	6	Ali Bey (Enderuni-Hanende)	0,051
2	Zekai Dede	0,122	6	Haşim Bey	0,051
3	Ahmet Irsoy (Hafız-Zekaizade)	0,102	6	Medeni Aziz Efendi	0,051
4	Dellalzade	0,082	6	Mustafa Sunar	0,051
4	Hacı Arif Bey	0,082	6	Şükrü Şenozan	0,051
4	Muallim İsmail Hakkı Bey	0,082	7	Ali Rifat Çağatay	0,041
4	Sultan III.Selim (İlhami)	0,082	7	Bimen Şen	0,041
5	Suphi Ezgi	0,071	7	Bolahenk Nuri Bey	0,041
5	Kanuni Hacı Arif Bey	0,061	7	Giriftzen Asım Bey	0,041

Table 11 Ranked Twenty Composers with Degree Centrality in Composer Network

Table 11 shows that Dede Efendi is the most central composer. Dede Efendi has a connection with Sultan III. Selim (İlhami), Kömürcüzade Mehmet Efendi H., and Numan Ağa. Also, as we mentioned in the Composer-Teacher Network part, he is the teacher of the most prominent composers which are located in critical ranks. Summing up all these parameters, we can say that the position of Dede Efendi is not unexpected or surprising. In the second rank, Tanburi Cemil Bey and Zekai Dede locate. Tanburi Cemil Bey is the teacher of four composers and has connection with four composers. Zekai Dede is the teacher of seven composers. Ahmet Irsoy (Hafız-Zekaizade) is in the third rank. He has a connection with modern composers like Suphi Ezgi, Münir Nurettin Selçuk, etc. Dellalzade, Hacı Arif Bey, Muallim İsmail Hakkı Bey, and Sultan III. Selim (İlhami) rank as 4. As we discussed in composer-teacher network part, Dellalzade, Hacı Arif Bey, and Muallim İsmail Hakkı Bey was highly prominent in the results of the analyses. But, Sultan III. Selim (İlhami) was not included in the tables. The reason of this situation is that Sultan III. Selim is the sultan of the Ottoman Empire. He learned the music from Tanburi İzak Efendi, and he taught to Sultan II. Mahmut (Adli). He had contributed to classical Turkish

music at an extreme level by supporting composers. Therefore, he located in the Table 11 as rank 4.

For understanding more efficiently, eigenvector centrality method is applied. As it is shown in the Table 12, Zekai Dede is the most central composer. He is in this position because of his teaching role. Then, Dede Efendi (1778-1846) ranks as 2. Dede Efendi is known as the greatest composer of his time. Even today, it is accepted that Dede Efendi is one of the most prominent composers. It can be clarified that the students of Dede Efendi made a great impact on classical Turkish music. At rank 3, Ahmet Irsoy (Hafız-Zekaizade) is located. Hacı Arif Bey ranks 4 and Dellalzade ranks 5. As previously mentioned, their connections are also important figures of classical Turkish music.

Rank	Composer	Eigenvector Centrality	Rank	Composer	Eigenvector Centrality
1	Zekai Dede	1,000	10	Sultan III.Selim (İlhami)	0,354
2	Dede Efendi	0,834	11	Hacı Faik Bey	0,328
3	Ahmet Irsoy (Hafız-Zekaizade)	0,781	12	Kanuni Hacı Arif Bey	0,318
4	Hacı Arif Bey	0,615	13	Muallim İsmail Hakkı Bey	0,311
5	Dellalzade	0,599	14	Mustafa Sunar	0,304
6	Suphi Ezgi	0,566	15	Ali Bey (Enderuni-Hanende)	0,299
7	Şükrü Şenozan	0,484	16	Kömürcüzade Mehmet Efendi H.	0,294
8	Haşim Bey	0,440	17	Kazasker Mustafa İzzet Efendi	0,291
9	Tanburi Cemil Bey	0,406	18	Udi Sami Bey	0,284
9	Eyyubi Mehmet Bey	0,406	19	Şevki Bey	0,268

Table 12 Ranked Twenty Composers with Eigenvector Centrality in Composer Network

Then, the betweenness centrality method is applied. Table 13 shows that Zekai Dede is the most central composer. Also, composers, who are located in first three ranks, are same as on apply of eigenvector centrality method. Strikingly, Tatyos Efendi holds the rank 4. As it is seen in Figure 22, Tatyos Efendi holds a critical position where he sits on the shortest paths that some of the composers can reach other composers by using his position in the graph.

Rank	Composer	Betweenness Centrality	Rank	Composer	Betweenness Centrality
1	Zekai Dede	0,132	11	Sultan III.Selim (İlhami)	0,043
2	Dede Efendi	0,130	12	Kanuni Hacı Arif Bey	0,042
3	Ahmet Irsoy (Hafız-Zekaizade)	0,104	13	Suphi Ezgi	0,040
4	Tatyos Efendi	0,098	14	Tanburi Ali Efendi	0,032
5	Tanburi Cemil Bey	0,091	15	Artaki Candan	0,029
6	Muallim İsmail Hakkı Bey	0,073	16	Medeni Aziz Efendi	0,028
7	Mustafa Sunar	0,065	17	Bolahenk Nuri Bey	0,025
8	Hacı Arif Bey	0,059	18	Udi Sami Bey	0,024
9	Şevki Bey	0,054	19	Latif Ağa	0,022
10	Dellalzade	0,050	20	Zeki Arif Ataergin	0,021

Table 13 Ranked Twenty Composers with Betweenness Centrality in Composer Network

In final, Modularity Algorithm (Blondel, et al., 2008) is applied to composer network. Modularity algorithm measures how well a network splits into modular communities. Then, Yifan Hu and Label Adjust metrics are applied respectively. Modularity is measured as 0,524. Number of Communities was calculated as 36. The size distribution graph can be seen in Figure 24. Since communities with low member moved away from the center, seven communities clustered in the core of the network. Communities that clustered in the center can be seen in Figure 24. Then, PageRank Algorithm (Brin and Page, 1998) is applied to the network with Epsilon = 0.001 and Probability = 0.85 values. The size of the nodes shows the magnitude of PageRank values. As it can be observed in the Figure 24, Sultan III. Selim (İlhami), Dede Efendi, Hacı Arif Bey, Zekai Dede, Tanburi Cemil Bey, Muallim İsmail Hakkı Bey, and Tatyos Efendi have the highest PageRank values in the seven clustered communities respectively. Top 20 PageRank values can be seen in Table 14.

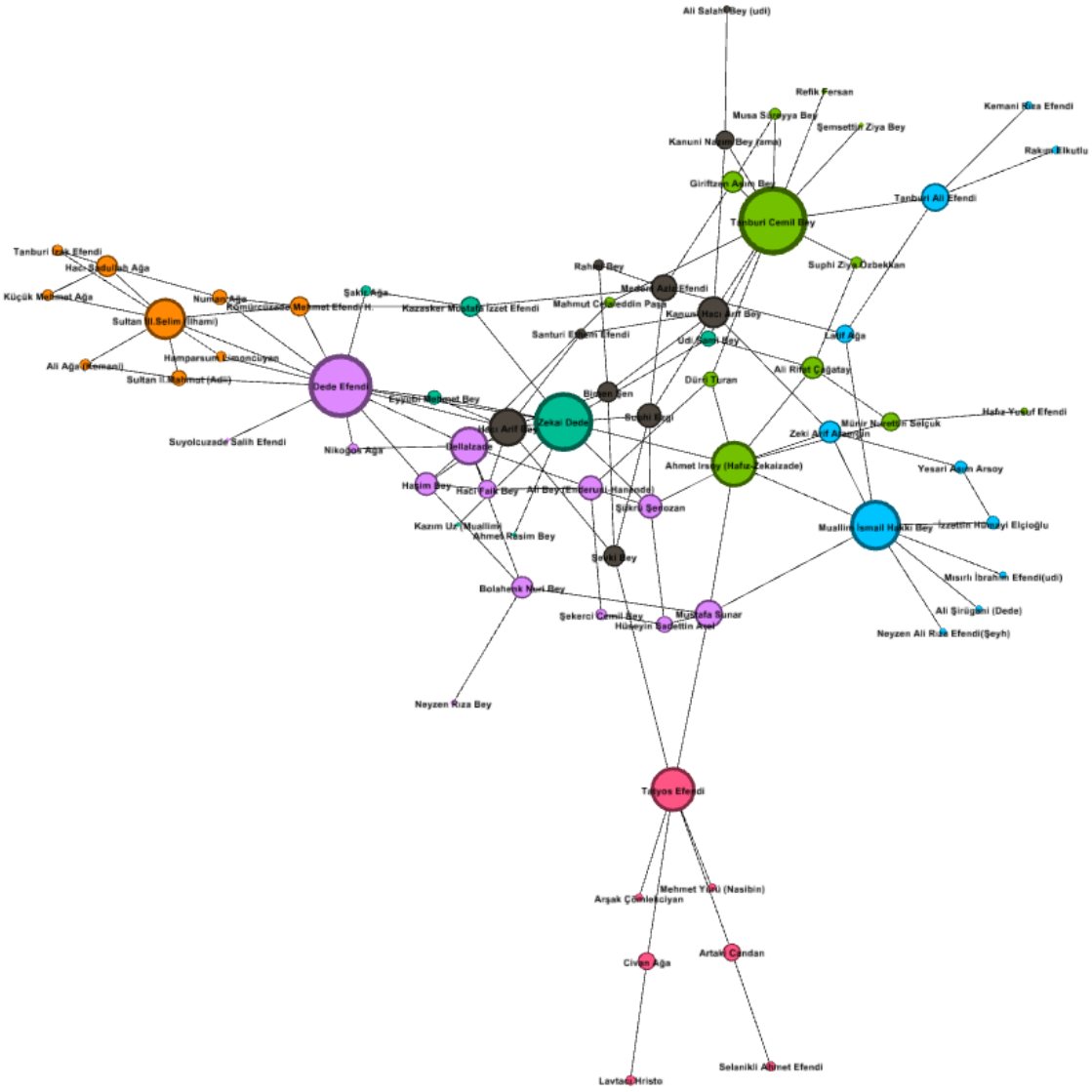


Figure 24 Modularity of Composer Network in centered (Isolates are removed)

Rank	Composer	PageRank	Rank	Composer	PageRank
1	Tanburi Cemil Bey	0,043	9	Kanuni Hacı Arif Bey	0,020
2	Dede Efendi	0,040	10	Hafız Post	0,019
3	Zekai Dede	0,037	11	Tanburi Ali Efendi	0,018
4	Muallim İsmail Hakkı Bey	0,031	11	Mustafa Sunar	0,018
4	Ahmet Irsoy (Hafız-Zekaizade)	0,031	12	Medeni Aziz Efendi	0,017
5	Tatyos Efendi	0,028	13	Ali Bey (Enderuni-Hanende)	0,016
6	Sultan III.Selim (İlhami)	0,026	14	Haşim Bey	0,015
7	Dellalzade	0,024	14	Şükrü Şenozan	0,015
7	Hacı Arif Bey	0,024	14	Zeki Arif Ataergin	0,015
8	Suphi Ezgi	0,021	15	Ali Rifat Çağatay	0,014

Table 14 Ranked Twenty Composers with PageRank in Composer Network

It can be seen in Table 14 that Tanburi Cemil Bey is the most central composer. In second rank, Dede Efendi is located. Zekai Dede is in the third rank. Muallim İsmail Hakkı Bey and Ahmet Irsoy (Hafız-Zekaizade) is placed in rank 4. Tatyos Efendi holds the position of rank 5. At rank 6, Sultan III. Selim (İlhami) is located with the help of his connections.

3.12. Measuring Relations of Composers using Maqam and Tempo Similarity

3.12.1. Parameter One: Maqam

Firstly, the relationship of the composers is measured with maqam similarity using average weighted degree. Average Weighted Degree is 0,3256. Via this method, average of the sum of weights of the edges of nodes is measured. By this way, the influences of the composers are revealed.

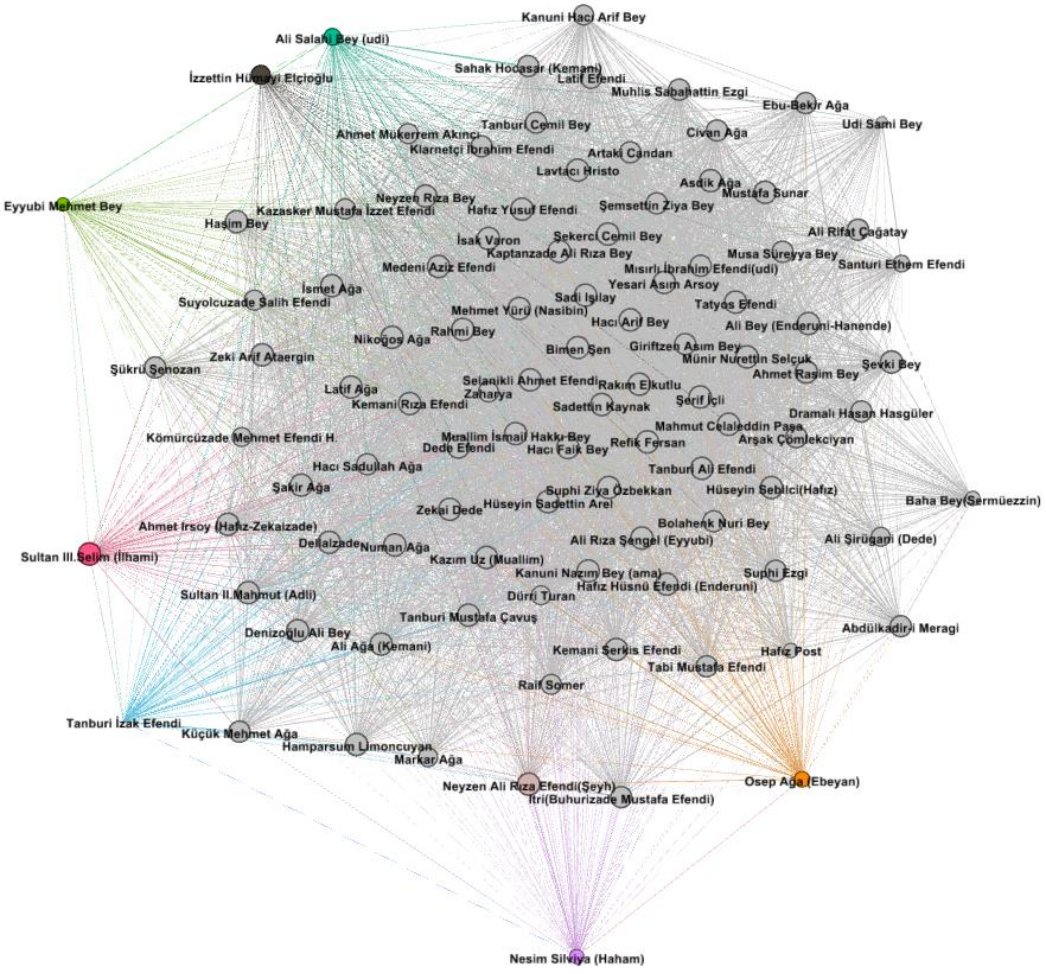


Figure 25 Average Weighted Degree of the Composers with Maqam Similarity

As it can be seen in Figure 25, Nesim Silviya (Haham), Eyyubi Mehmet Bey, Tanburi İzak Efendi, İzzettin Hümayi Elçioğlu, Osep Ağa (Ebeyan), Sultan III. Selim (İlhami), Ali Salahi Bey (Udi), and Neyzen Ali Rıza Efendi (Şeyh) have different color than gray and quite away from clustered center of the network. These composers have the lowest average weighted degree in the network as it is given in Table 15. It is mentioned that 181 distinct maqams had been used by the composers. When we analyzed data, we saw that Nesim Silviya (Haham), who has the lowest average weighted degree with maqam similarity, used 12 different maqams which are Acem Kürdi, Bestenigar, Dilkeşhaveran, Dilnişin, Ferahfeza, Isfahan, Isfahanek, Segah, Araban, Selmek, Suzinak, Tebriz, and Yegah in his works. In Table 16, the number of use by the composers of these 12 maqams, that were used by Nesim Silviya (Haham) are given. For better understanding, Table 17 shows the number of use of Top 20 maqams by the composers. The data show that he used only three popular used maqams which are Suzinak, Acem Kürdi, and Bestenigar in the Table 16. The other nine maqams that are used by him are not commonly used maqams. Especially, Isfahanek (6), Segah Araban (6), Selmek (9), Dilnişin (9), and Tebriz (13) are one of the fewest maqams which are used by the composers. Therefore, he differs from the network. When we analyzed, Eyyubi Mehmet Bey's works, we saw that he used Bayati, Ferahfeza, Hicazkar, Mahur, Suzidil and Suzinak maqams. But, when we look at the number of use of these maqams, we saw the half of his work include Bayati, Hicazkar, and Suzinak maqams was on our Top 20 list that we gave in Table 17. The Average Weighted Degree value 0,124 of Eyyubi Mehmet Bey showed that he differs from the network. Then, we realized that the number of his works was 13. Therefore, it can be interpreted that he differs from the network since the number of his works are low when it is compared to our used data. In Öztuna (1990) it is mentioned that Neyzen Ali Rıza Efendi (Şeyh) was pretty enthusiastic with composing in rare used maqams. Moreover, Table 18 shows that ranked twenty composers with average weighted degree with maqam similarity.

Rank	Composer	Average Weighted Degree	Rank	Composer	Average Weighted Degree
1	Nesim Silviya (Haham)	0,115	11	Küçük Mehmet Ağa	0,204
2	Eyyubi Mehmet Bey	0,124	12	Şükrü Şenozan	0,205
3	Tanburi İzak Efendi	0,137	13	Markar Ağa	0,207
4	İzzettin Hümayi Elçioğlu	0,160	14	Baha Bey(Sermüezzin)	0,212
5	Osep Ağa (Ebeyan)	0,167	15	Abdülkadir-i Meragi	0,216
6	Sultan III.Selim (İlhami)	0,168	16	Haşim Bey	0,220
7	Ali Salahi Bey (udi)	0,189	17	Hamparsum Limoncuyan	0,222
8	Neyzen Ali Rıza Efendi(Şeyh)	0,192	18	Ebu-Bekir Ağa	0,227
9	Itri(Buhurizade Mustafa Efendi)	0,195	19	Ali Şirügani (Dede)	0,233
10	Udi Sami Bey	0,203	20	Hafız Post	0,246

Table 15 Ranked Min to Max Twenty Composers with Average Weighted Degree with Maqam Similarity

Maqam	Number of Use	Maqam	Number of Use
Acem Kürdi	78	Isfahanek	6
Bestenigar	79	Segah Araban	6
Dilkeşhaveran	39	Selmek	9
Dilnişin	9	Suzinak	167
Ferahfeza	52	Tebriz	13
Isfahan	66	Yegah	59

Table 16 The Number of Use by the Composers of Maqams are used by Nesim Silviya (Haham)

Rank	Maqam	The Number of Use	Rank	Maqam	The Number of Use
1	Hicaz	441	11	Hicazkar	145
2	Uşşak	320	12	Muhayyer	110
3	Nihavend	271	13	Saba	110
4	Hüzzam	267	14	Acemaşiran	105
5	Kürdilihicazkar	239	15	Segah	100
6	Rast	227	16	Bestenigar	79
7	Hüseyni	191	17	Acem Kürdi	78
8	Suzinak	167	18	Bayati	73
9	Mahur	150	19	Şedaraban	73
10	Karcığar	147	20	Ferahnak	69

Table 17 The Number of Use of Top 20 Maqams by The Composers.

Rank	Composer	Average Weighted Degree	Rank	Composer	Average Weighted Degree
1	Muallim İsmail Hakkı Bey	0,517	9	Mahmut Celaleddin Paşa	0,427
2	Sadettin Kaynak	0,493	9	Yesari Asım Arsoy	0,427
3	Bimen Şen	0,487	10	Zekai Dede	0,424
4	Hacı Arif Bey	0,474	11	Suphi Ziya Özbekkan	0,423
5	Refik Fersan	0,466	12	Münir Nurettin Selçuk	0,422
6	Rakım Elkutlu	0,437	13	Giriftzen Asım Bey	0,417
6	Şekerci Cemil Bey	0,437	14	Tatyos Efendi	0,414
6	Dede Efendi	0,437	15	Hacı Faik Bey	0,412
7	Mısırlı İbrahim Efendi(udi)	0,434	16	Şerif İçli	0,409
8	Selanikli Ahmet Efendi	0,429	17	Arşak Çömlekciyan	0,407

Table 18 Ranked Twenty Composers with Average Weighted Degree with Maqam Similarity

Secondly, using degree centrality (Freeman, 1978), tie number of composers upon each other are shown in Figure 26 with maqam. Average Degree is measured as 96,747.

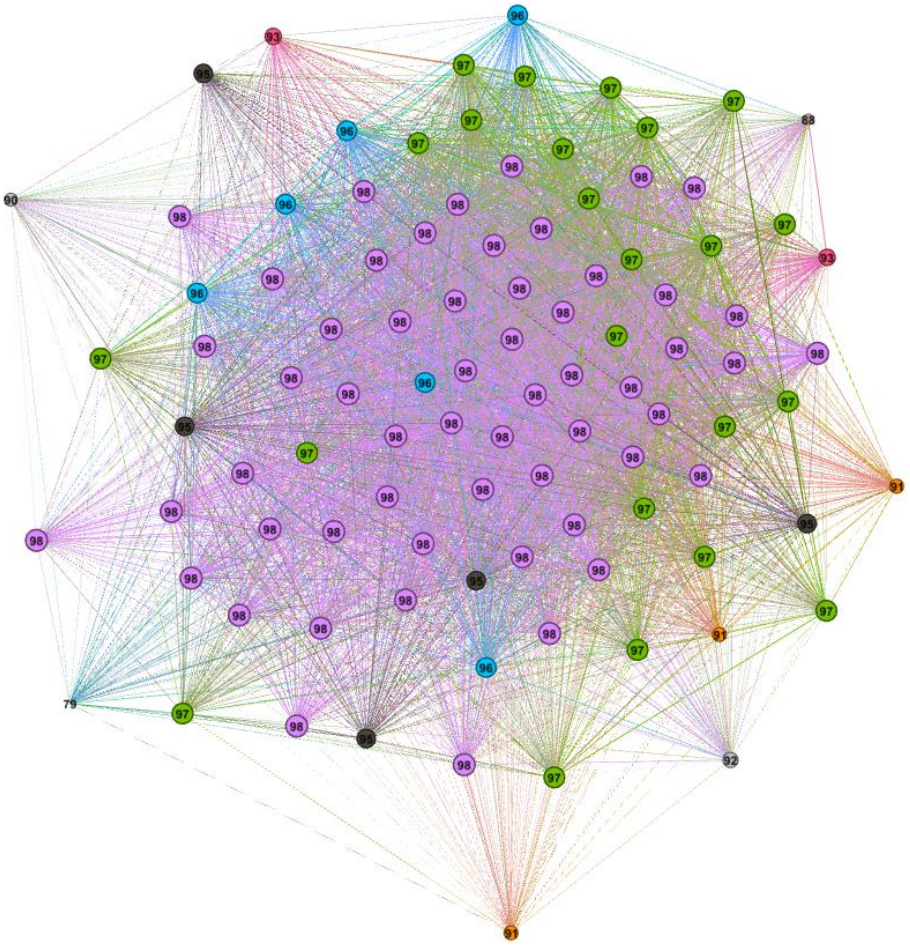


Figure 26 Percentage of Connection between The Composers with Maqam Similarity

In final, Modularity Algorithm (Blondel, et al., 2008) is applied to maqam similarity graph of composers. Then, Yifan Hu and Label Adjust metrics are applied respectively. For lightening graph, we used Average Weighted Degree value 0,3256 as a start point for data and deleted numbers under 0,3256. By this way, we gathered more reasonable, visual, and interpretable graph. Modularity is measured as 0,161. Number of Communities was calculated as 3. The size distribution graph can be seen in Figure 27. Also, clustered communities can be seen in Figure 27. Then, PageRank Algorithm (Brin and Page, 1998) is applied to the network with Epsilon = 0.001 and Probability = 0.85 values. Top 20 PageRank values can be seen in Table 19.

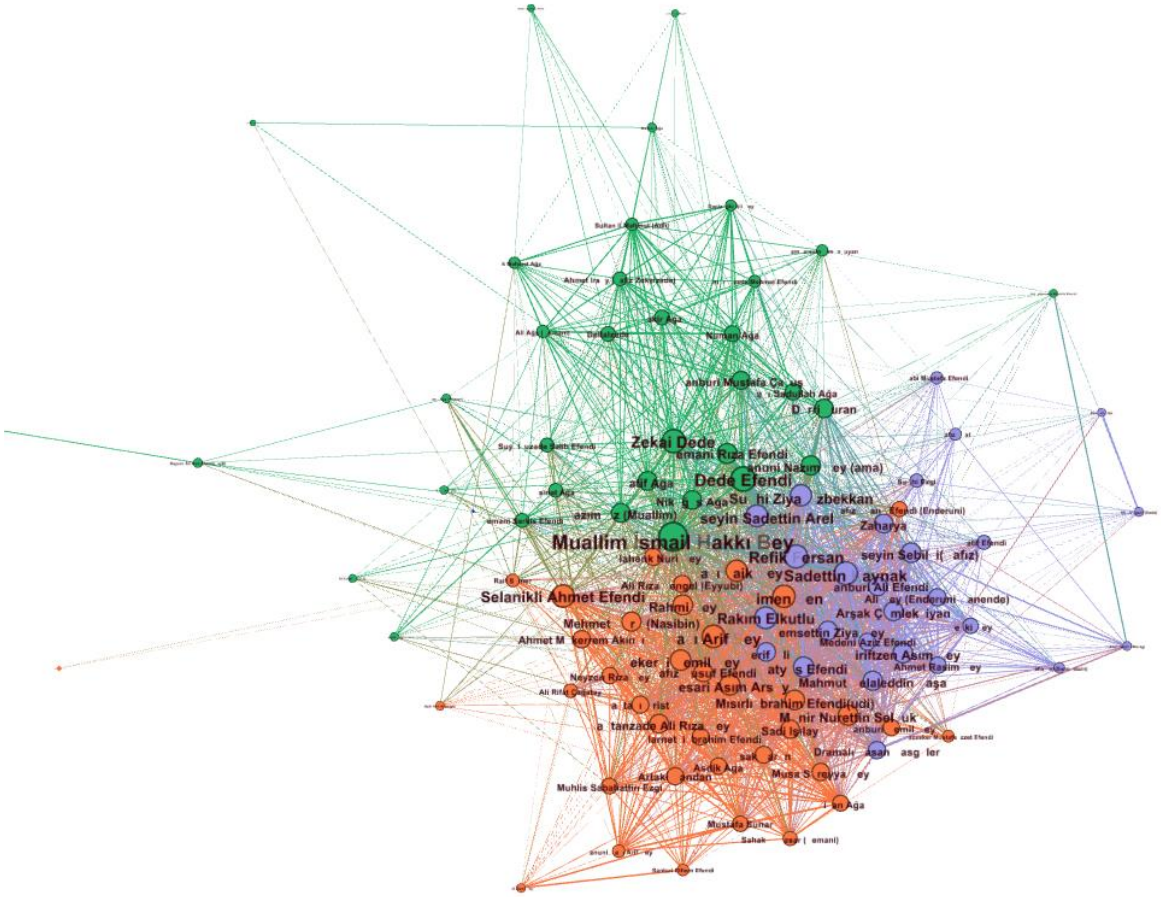


Figure 27 Modularity of the Composers with Maqam Similarity

Rank	Composer	PageRank	Rank	Composer	PageRank
1	Muallim İsmail Hakkı Bey	0,0205	8	Suphi Ziya Özbekkan	0,0147
2	Dede Efendi	0,0172	8	Hacı Faik Bey	0,0147
3	Zekai Dede	0,0162	9	Şekerci Cemil Bey	0,0141
3	Refik Fersan	0,0162	10	Yesari Asım Arsoy	0,0139
3	Sadettin Kaynak	0,0162	10	Tatyos Efendi	0,0139
4	Hacı Arif Bey	0,0157	11	Münir Nurettin Selçuk	0,0137
5	Selanikli Ahmet Efendi	0,0156	12	Rahmi Bey	0,0136
6	Bimen Şen	0,0155	13	Kemani Rıza Efendi	0,0135
7	Hüseyin Sadettin Arel	0,0152	14	Giriftzen Asım Bey	0,0134
7	Rakım Elkutlu	0,0152	14	Mısırlı İbrahim Efendi(udi)	0,0134

Table 19 PageRank of the Composers with Maqam Similarity

3.12.2. Parameter Two: Tempo

Like in the maqam similarity part, firstly, average weighted degree is used as a measure method. Average Weighted Degree is 0,6068.

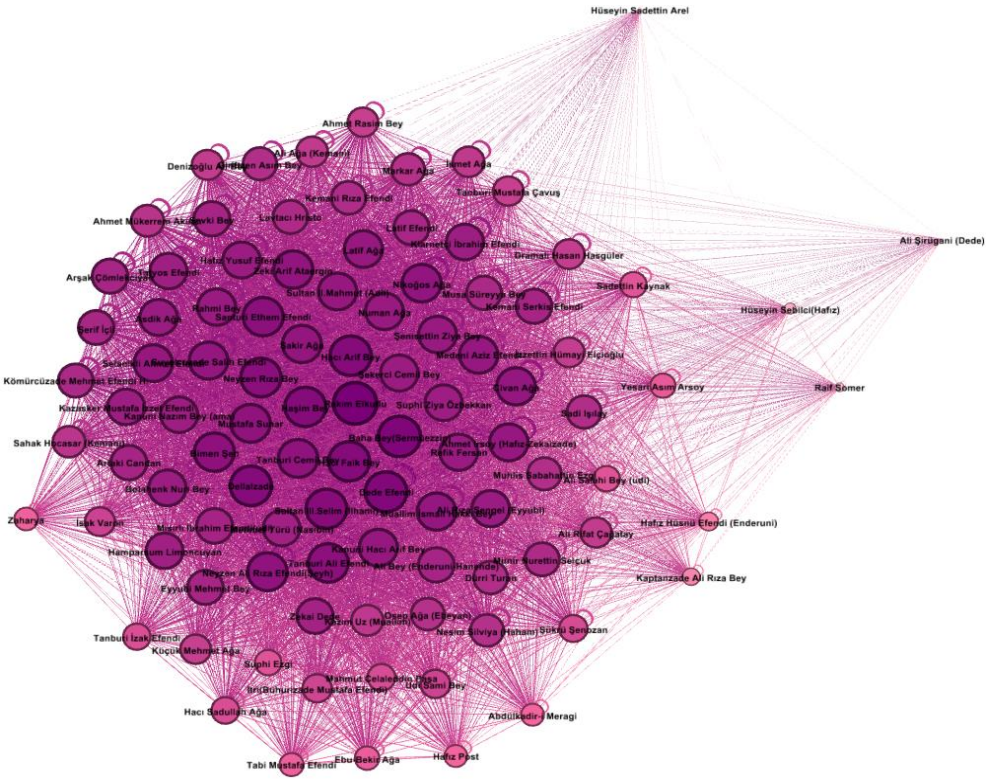


Figure 28 Average Weighted Degree of the Composers with Tempo Similarity

It is seen in Figure 28 that Ali Şirugani (Dede) and Hüseyin Sadettin Arel are extremely away from the center of the network since the weighted degree of them is 0.178 and 0.210 respectively as it is given in Table 20. These values show that they have the lowest

similarity with tempo in the network. It is mentioned about Ali Şirugani (Dede) in the Özcan (2016) as the composer who composed the most religious music in classical Turkish music. When we looked at the data of Ali Şirugani's and Hüseyin Sadettin Arel's works, it is seen that tempos which they used is the tempo that is used in religious music. The tempo which separates Ali Şirugani (Dede) and Hüseyin Sadettin Arel in the composer network is "Durak Evferi". It is given in a writing of Suphi Ezgi in 1935 that he and Hüseyin Sadettin Arel put the Durak Evferi tempo into a certain rhythm with a measure and restored it to its original version (Hammarlund, Olsson, and Ozdalga, 2004).

Rank	Composer	Average Weighted Degree	Rank	Composer	Average Weighted Degree
1	Ali Şirügani (Dede)	0,178	11	Ebu-Bekir Ağa	0,493
2	Hüseyin Sadettin Arel	0,210	12	Yesari Asım Arsoy	0,503
3	Raif Somer	0,279	13	Sadettin Kaynak	0,518
4	Hüseyin Sebilci(Hafız)	0,309	14	Ali Salahi Bey (udi)	0,520
5	Kaptanzade Ali Rıza Bey	0,397	14	Suphi Ezgi	0,520
6	Hafız Hüsnü Efendi (Enderuni)	0,417	15	Tanburi İzak Efendi	0,532
7	Hafız Post	0,470	16	Hacı Sadullah Ağa	0,536
8	Abdülkadir-i Meragi	0,471	17	Mahmut Celaleddin Paşa	0,538
9	Zaharya	0,481	18	Şükrü Şenozan	0,543
10	Tabi Mustafa Efendi	0,485	19	Itri(Buhurizade Mustafa Efendi)	0,559

Table 20 Ranked Min to Max Twenty Composers with Average Weighted Degree with Tempo Similarity

The number of works by Ali Şirugani (Dede) (Unknown-1714) is 13 in our data. The tempo Durak Evferi which forms two of his works is only used in religious music. The tempo Evsat that forms four of his works is mostly used in religious, but also is used in non-religious music. The tempo Düyek that forms four of his works and the tempo Sofyan that forms three of his works are widely used in both religious and non-religious music.

The number of works of Hüseyin Sadettin Arel (1880-1955) is 199 in our data. The tempo Durak Evferi forms one hundred of his works. The data show that Arel gave high importance to this particular tempo. It can be deduced that the rediscovery of the tempo Durak Evferi by Ezgi and Arel was highly special for Arel since they technically modernized it. Therefore, he preferred to use this tempo in more than half of his work.

In the light of the above findings, it can be interpreted that Ali Şirugani (Dede) and Hüseyin Sadettin Arel has a distinct position in the network graph because of their choices about music style and preferences which depend on their own thoughts.

Rank	Composer	Average Weighted Degree	Rank	Composer	Average Weighted Degree
1	Rakım Elkutlu	0,756	10	Santuri Ethem Efendi	0,711
2	Baha Bey(Sermüezzin)	0,739	11	Bimen Şen	0,709
3	Dede Efendi	0,734	12	Neyzen Ali Rıza Efendi(Şeyh)	0,704
4	Dellalzade	0,727	13	Mustafa Sunar	0,702
5	Hacı Arif Bey	0,726	13	Tanburi Cemil Bey	0,702
6	Haşim Bey	0,724	14	Nikoğos Ağa	0,697
6	Hacı Faik Bey	0,724	14	Zeki Arif Ataergin	0,697
7	Sultan III.Selim (İlhami)	0,721	15	Şakir Ağa	0,694
8	Neyzen Rıza Bey	0,715	16	Civan Ağa	0,693
9	Tanburi Ali Efendi	0,712	17	Muallim İsmail Hakkı Bey	0,692

Table 21 Ranked Twenty Composers with Average Weighted Degree with Tempo Similarity

As it is seen in the Table 21 and Figure 28, then composers clustered in the center. It can be deduced that tempos which they used have similarity extremely. This shows that governing tempos are highly popular among composers. Also, the number of use is highly similar since the working principle of Cosine Similarity.

Rank	Composer	Average Weighted Degree	Rank	Composer	Average Weighted Degree
1	Dellalzade	0,965	10	Bolahenk Nuri Bey	0,873
2	Hamparsum Limoncuyan	0,949	11	Bimen Şen	0,863
3	Sultan III.Selim (İlhami)	0,937	12	Rakım Elkutlu	0,862
4	Haşim Bey	0,919	13	Hacı Faik Bey	0,861
5	Tanburi Ali Efendi	0,915	14	Ahmet Irsoy (Hafız-Zekaizade)	0,858
6	Baha Bey(Sermüezzin)	0,906	14	Numan Ağa	0,858
6	Neyzen Ali Rıza Efendi(Şeyh)	0,906	15	Kazasker Mustafa İzzet Efendi	0,854
7	Zekai Dede	0,902	16	Şakir Ağa	0,851
8	Kanuni Hacı Arif Bey	0,886	17	Osep Ağa (Ebeyan)	0,850
9	Nikoğos Ağa	0,877	17	Nesim Silviya (Haham)	0,850

Table 22 Dede Efendi's Similarity- Ranked Twenty Composers with Average Weighted Degree with Tempo Similarity

In Table 7, degree centrality of Dede Efendi, who is in rank two, was 0,092 in the Composer-Teacher Network part. In Table 8, eigenvector centrality of Dede Efendi was 1,000. Also, in Table 10, degree centrality of Dede Efendi with ranked one was 0,133 and in Table 11, eigenvector centrality of him was 0,912. Therefore, we were curious about the

relationship between him and his student and his network. In the Table 22, Similarity of Dede Efendi and Dellalzade was ranked one with 0,965. It is known that Dellalzade was the student of Dede Efendi. Second ranked Hamparsum Limoncuyan also was a student of Dede Efendi. Sultan III. Selim (İlhami) with ranked three was highly close to him. Dede Efendi increased his reputation with the great support of him. Before the days Dede Efendi had got his "Dede" title, Dede Efendi was suffering in the Mevlevihane. He composed "Zülfündedir benim baht-ı siyâhım" named composition in the second year of his suffer. This composition influenced the folk extremely. Sultan III. Selim (İlhami) was curious about Dede Efendi for his different melody and tonality structure. Then, Sultan III. Selim (İlhami) summoned Dede Efendi to the palace and listened to him. After this event, Sultan III. Selim (İlhami) told the head of Mevlevihane to forgive the suffer of Dede Efendi. Then, Dede Efendi was forgiven, and his suffering had been completed. Rank 4 is Haşim Bey, who learned music from Dede Efendi and Dellalzade. Rank 7 is Zekai Dede. His teachers were Kazasker Mustafa İzzet Efendi, Dede Efendi, and Dellalzade. Rank 9 is Nikoğos Ağa was student Dede Efendi and Dellalzade. Dellalzade and Haşim Bey, who are students of Dede Efendi, are teachers of Bolahenk Nuri Bey with Rank 10. Bimen Şen was student of Hacı Arif Bey, who is not shown in Table 22, but Hacı Arif Bey was also a student of Dede Efendi, Zekai Dede, and Haşim Bey. Hacı Faik Bey was student of Dellalzade and Haşim Bey. Ahmet Irsoy (Hafız-Zekaizade) was student of Zekai Dede, who learned music from Dede Efendi. Numan Ağa was a friend of Dede Efendi. Kazasker Mustafa Efendi was student of Kömürcüzade Mehmet Efendi H., who is a is friend of Dede Efendi, and Şakir Ağa whom teacher was Dede Efendi.

The above findings imply that tempos which are used by composers are influenced from a teacher student relationship and composer network in general. As it can be observed from Figure 28, composers are clustered in the center with tempo similarity.

Then, using degree centrality (Freeman, 1978), the tie number of composers upon each other are shown in Figure 29 with tempo. Average Degree is 99,798. With regard to these measures, we can say that most of the composers had used at least one same tempo. Also, 88,99% of composers connected all the other composers in the network. 10,01% of composers connected 99% of the other composers. 1,01% of composers connected 90% of the other composers in the network.

After these measures, data table with tempo is analyzed. In the analysis, it is seen that Ali Şirügani (Dede) has no connection with Hacı Sadullah Ağa, Eyyubi Mehmet Bey, Tabi Mustafa Efendi, Zaharya, Mahmut Celaleddin Paşa, Ahmet Mükerrem Akıncı, Rahmi Bey, Ebu-Bekir Ağa, Kömürcüzade Mehmet Efendi H., and Küçük Mehmet Ağa.

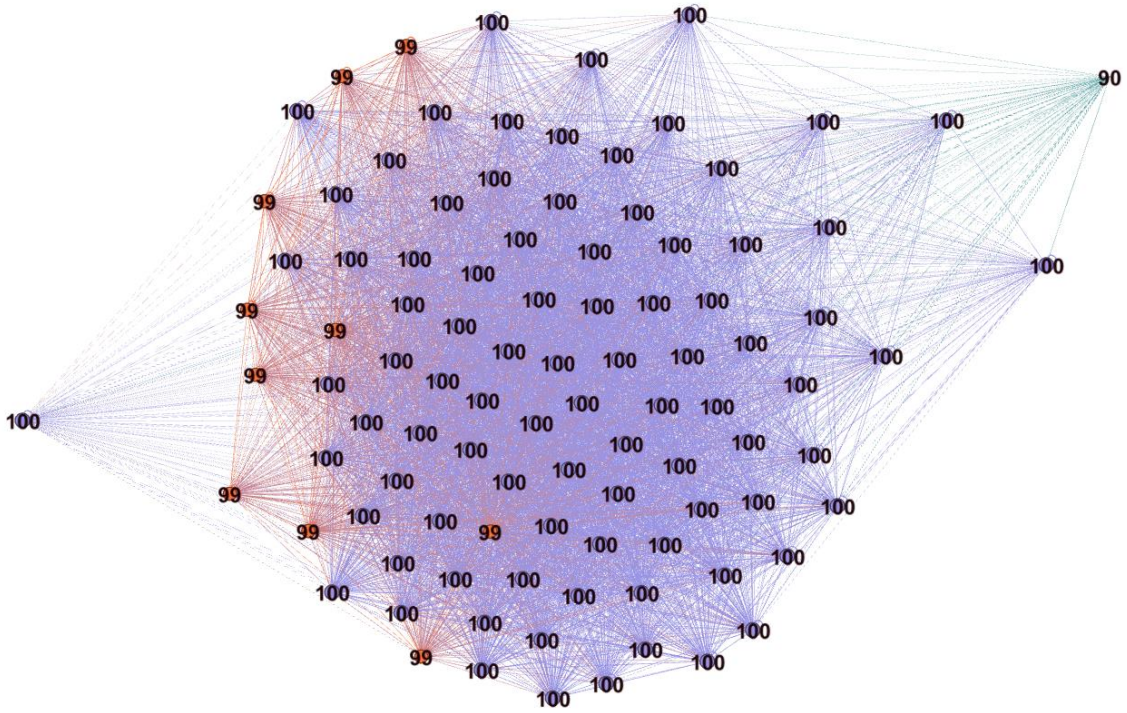


Figure 29 Percentage of Connection between The Composers with Tempo Similarity

In final, Modularity Algorithm (Blondel, et al., 2008) is applied to the tempo similarity graph of composers. Then, Fruchterman Reingold and Label Adjust metrics are applied respectively. In this part, the graph was very difficult for interpretation. Therefore, we used Average Weighted Degree value 0,6068 as a start point for data and deleted numbers under 0,6068. By this way, we gathered more sensible, visual, and interpretable graph. Modularity is measured as 0,146. Number of Communities was calculated as 4. The size distribution graph can be seen in Figure 30. Also, clustered communities can be seen in Figure 30. Then, PageRank Algorithm (Brin and Page, 1998) is applied to the network with Epsilon = 0.001 and Probability = 0.85 values. Top 20 PageRank values can be seen in Table 23.

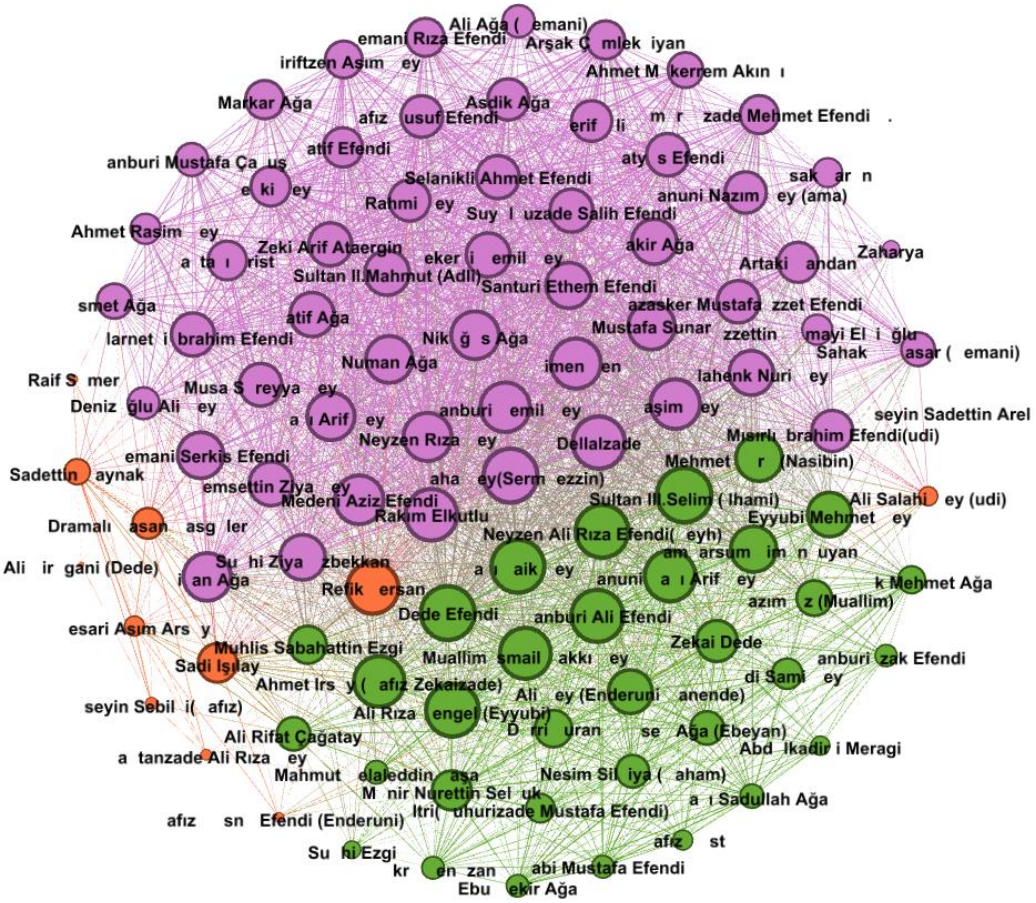


Figure 30 Modularity of the Composers with Tempo Similarity

Rank	Composer	PageRank	Rank	Composer	PageRank
1	Sultan III.Selim (İlhami)	0,0143	6	Muallim İsmail Hakkı Bey	0,0135
2	Baha Bey(Sermüezzin)	0,0142	7	Kanuni Hacı Arif Bey	0,0134
2	Dede Efendi	0,0142	8	Ahmet Irsoy (Hafız-Zekaizade)	0,0133
3	Hacı Faik Bey	0,0140	9	Bimen Şen	0,0132
3	Ali Rıza Şengel (Eyyubi)	0,0140	10	Haşim Bey	0,0131
3	Neyzen Ali Rıza Efendi(Şeyh)	0,0140	10	Tanburi Cemil Bey	0,0131
4	Dellalzade	0,0138	11	Medeni Aziz Efendi	0,0129
4	Tanburi Ali Efendi	0,0138	12	Neyzen Rıza Bey	0,0128
5	Rakım Elkutlu	0,0136	13	Nikoğos Ağa	0,0127
5	Refik Fersan	0,0136	13	Civan Ağa	0,0127

Table 23 PageRank of the Composers with Tempo Similarity

3.12.3. Parameter Three: Maqam and Tempo

As previously studied in the maqam and tempo similarity parts, firstly, average weighted degree is used as a measure method. Average Weighted Degree is 0,4612. Then, OpenOrd

and Label Adjust metrics are applied respectively. Figure 31 shows the average weighted degree of the composers with the maqam and tempo similarity.

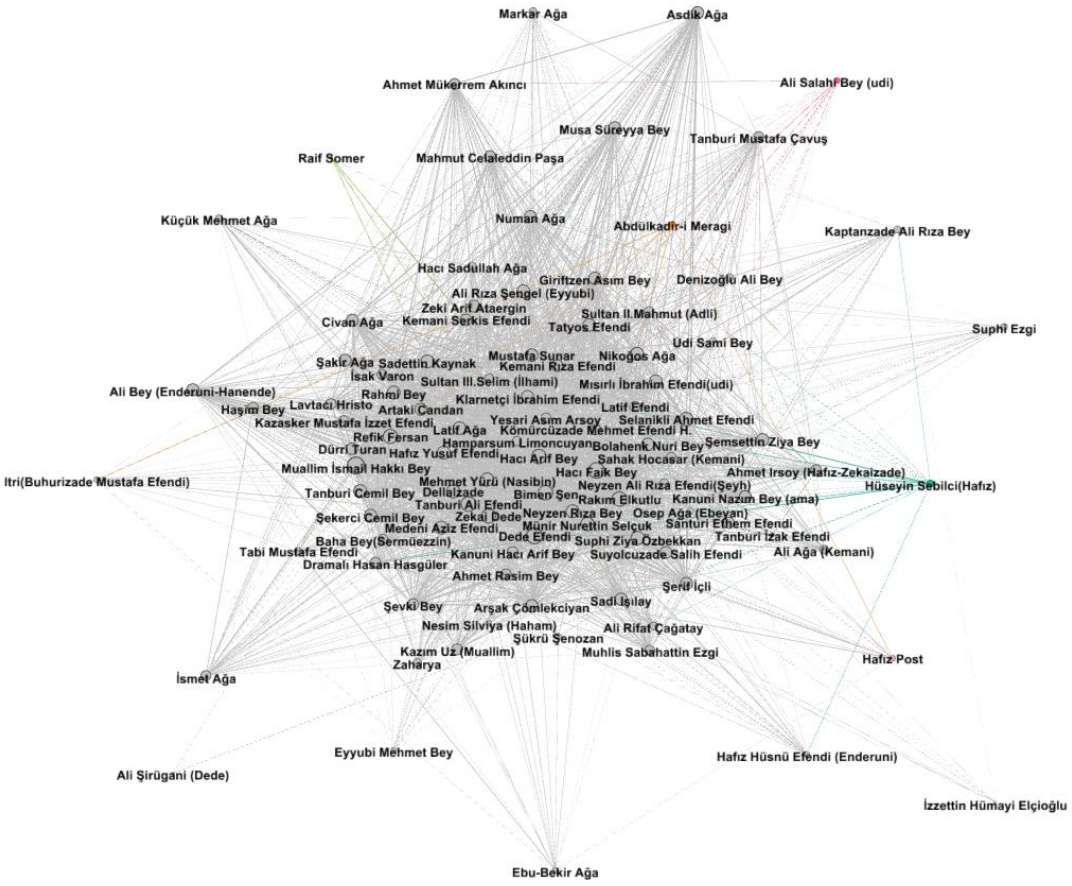


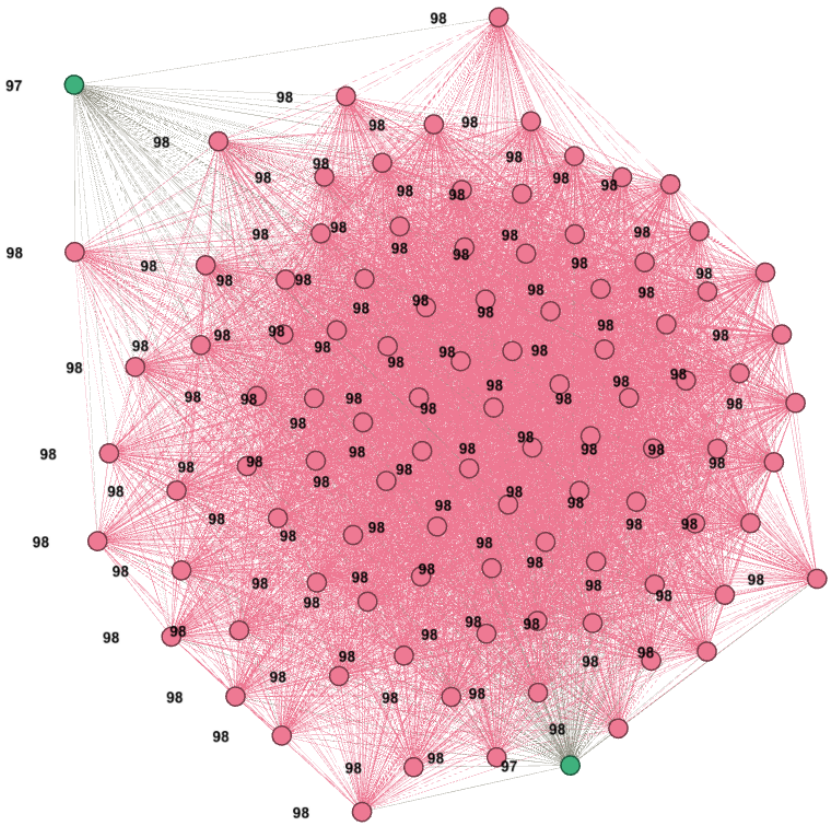
Figure 31 Average Weighted Degree of the Composers with Maqam and Tempo Similarity

Rank	Composer	Average Weighted Degree	Rank	Composer	Average Weighted Degree
1	Ali Şirügani (Dede)	0,196	11	İzzettin Hümayi Elçioğlu	0,360
2	Raif Somer	0,263	12	Hafız Hüsnü Efendi (Enderuni)	0,363
3	Hüseyin Sadettin Arel	0,289	13	Şükrü Şenozan	0,364
4	Tanburi İzak Efendi	0,325	14	Tabi Mustafa Efendi	0,366
5	Abdülkadir-i Meragi	0,333	15	Itri(Buhurizade Mustafa Efendi)	0,367
6	Ali Salahi Bey (udi)	0,344	16	Udi Sami Bey	0,373
7	Hüseyin Sebilci(Hafız)	0,345	17	Eyyubi Mehmet Bey	0,376
8	Hafız Post	0,348	18	Küçük Mehmet Ağa	0,380
9	Ebu-Bekir Ağa	0,350	19	Kaptanzade Ali Rıza Bey	0,381
10	Nesim Silviya (Haham)	0,356	19	Osep Ağa (Ebeyan)	0,381

Table 24 Ranked Min to Max Twenty Composers with Average Weighted Degree with Maqam and Tempo Similarity

Then, using degree centrality (Freeman, 1978), the tie number of composers upon each other are shown in Figure 32 with maqam and tempo mixture. Average Degree is 97,980.

With regard to these measures, we can say that most of the composers had used at least one same tempo. Also, 97 composers connected all the other composers in the network. But, 2 composers connected other 97 composers and have not connection between them. These values can be seen in Table 24. Composers who have not connected each other are Ali Şirügani (Dede) and Eyyubi Mehmet Bey. When we analyzed their works, we showed that Ali Şirügani (Dede) used ten unique maqams that are Nühüft, Pençgah, Uşşak, Acem, Hicaz, Evc, Segah, Rast, Hüseyni Aşiran, and Gülizar and four unique tempos which are Durak Evferi, Evsat, Düyek, and Sofyan. We also realized that Eyyubi Mehmet Bey used six unique maqams that are Suzidil, Mahur, Hicazkar, Suzinak, Bayati, and Ferahfeza and twelve unique tempos which are Ağır Aksak Semai, Darb-ı Fetih, Muhammes, Devr-i Hindi, Aksak Semai, Havi, Sengin Semai, Yürük Semai, Türk Aksağı, Hafif, Çenber, and Zencir. As it is seen, there is no connection at all. It is mentioned in the Öztuna (1990) that Eyyubi Mehmet Bey had never composed a religious music and Ali Şirügani (Dede) had composed religious music at most. This situation clarifies why there is no connection between them.


98
97
98
98
98

In final, Modularity Algorithm (Blondel, et al., 2008) is applied to maqam and tempo similarity graph of composers. Then, Yifan Hu Proportional and Label Adjust metrics are applied respectively. In this part, the graph was hardly difficult for interpretation. For this reason, we used Average Weighted Degree value 0,4712 as a start point for data and deleted numbers under 0,4712. By this way, we gathered more sensible, visual, and interpretable graph. Modularity is measured as 0,118. Number of Communities was calculated as 3. The size distribution graph can be seen in Figure 33. Also, clustered communities can be seen in Figure 33. Then, PageRank Algorithm (Brin and Page, 1998) is applied to the network with Epsilon = 0.001 and Probability = 0.85 values. Top 20 PageRank values can be seen in Table 25.

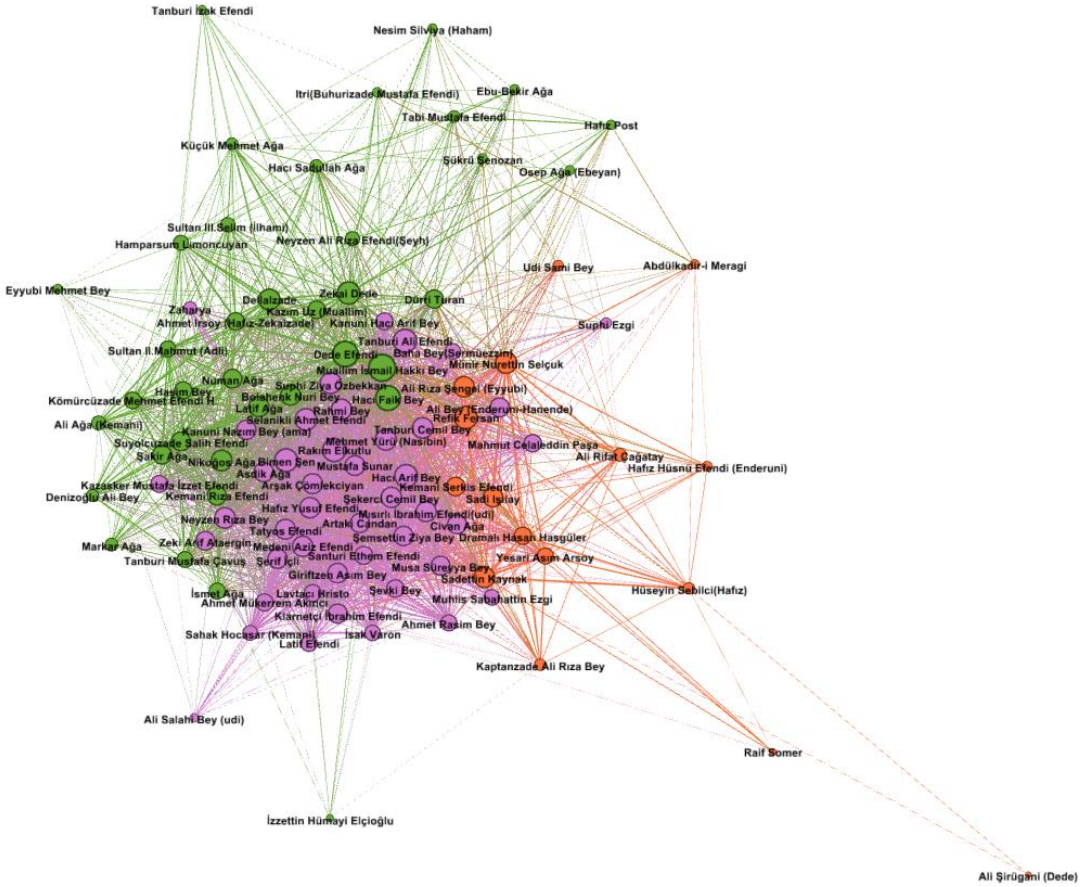


Figure 33 Modularity of the Composers with Maqam and Tempo Similarity

Rank	Composer	PageRank	Rank	Composer	PageRank
1	Muallim İsmail Hakkı Bey	0,0186	10	Dellalzade	0,0136
2	Dede Efendi	0,0166	11	Rahmi Bey	0,0135
3	Hacı Faik Bey	0,0164	12	Münir Nurettin Selçuk	0,0134
4	Rakım Elkutlu	0,0153	13	Tanburi Cemil Bey	0,0133
5	Refik Fersan	0,0151	13	Nikoğos Ağa	0,0133
5	Tanburi Ali Efendi	0,0151	13	Medeni Aziz Efendi	0,0133
6	Bimen Şen	0,0150	14	Hafız Yusuf Efendi	0,0132
7	Zekai Dede	0,0149	14	Neyzen Rıza Bey	0,0132
8	Hacı Arif Bey	0,0148	14	Suphi Ziya Özbekkan	0,0132
9	Selanikli Ahmet Efendi	0,0142	14	Latif Ağa	0,0132

Table 25 PageRank of the Composers with Maqam and Tempo Similarity

After studies above in this part, we studied the relations among composers one by one with maqam and tempo similarity with average weighted degree measure for deeper interpretations in the findings chapter.

CHAPTER 4

FINDINGS

In this chapter, we studied the relations among composers one by one with maqam and tempo similarity with average weighted degree measure for deeper interpretations.

When we analyzed Abdülkadir-i Meragi's similarity, Münir Nurettin Selçuk was the most similar to him with 0,67 weight. In Öztuna (1990), the secret of the success of Münir Nurettin Selçuk is given as his outstanding knowledge of the classical repertoire and skill of proficient imitation. Also, it is mentioned about that he imitated an old musical piece in his almost all works.

> The composition of Münir Bey for lyric of Ahmet Pasha is melodically similar to "Kar-ı Muhteşem" piece of Abdülkadir-i Meragi. Münir Bey quipped someday in a practice saying "I guess Master Meragi imitate his composition of 'Kar-ı Muhteşem' from our work.", and smiled. In fact, his composition of 'Erdi Bahar' contains overtones of 'Rehavi Yürük Semai' piece of Hafız Post (Bora, 2018, para. 242).

The second most similar composer to Abdülkadir-i Meragi is Itri (Buhurizade Mustafa Efendi) with 0,64 weight. Itri (Buhurizade Mustafa Efendi) comes as the very wise composer after the time of Abdülkadir-i Meragi (Öztuna, 1990). There are almost 300 years between Itri and Meragi. Itri may be influenced from Master Meragi since the outstanding popularity and extraordinary works of him. Third most similar composer to Meragi is Hafız Post with 0,59 weight. Hafız Post is connected to Meragi with the Meşk sequence and also Hafız Post is the teacher of Itri. In Figure 34, the Meşk sequence of Itri, Post, Meragi can be seen (Öztuna, 1990). Sequence in Figure 34 is from top (teacher) to down (student).

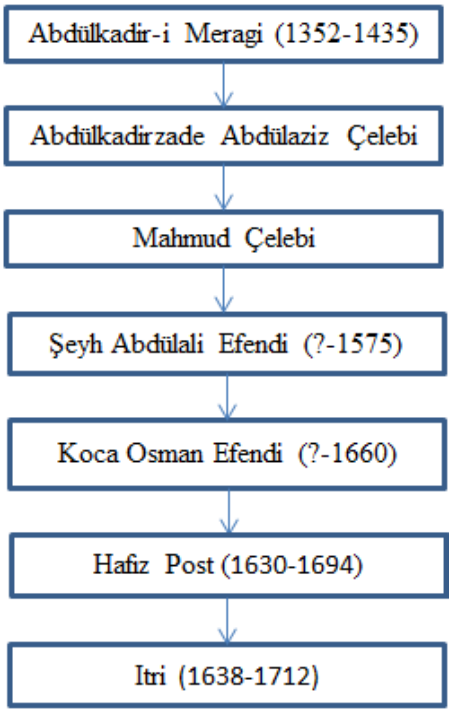


Figure 34 The Meşk Sequence from Teacher to Student

In Ahmet Irsoy (Hafız-Zekaizade)'s similarity, Dellalzade leads with 0,77 weight. As we mentioned before, the teacher and father of Ahmet Irsoy was Zekai Dede whom teacher was Dellalzade. Thus, the result makes sense. Not surprisingly, the second most similar to Ahmet Irsoy is Zekai Dede with 0,75 weight.

In Ali Ağa (Kemani)'s similarity, Sultan II. Mahmut (Adli) is the most similar to him with 0,76 weight. In second, Şakir Ağa comes with 0,74 weight. Şakir Ağa had taken the title of 'Favorite of Sultan' by Sultan II. Mahmut (Öztuna, 1990). Then, in third, Numan Ağa comes with 0,72. Numan Ağa was highly popular in the palace in the rule of Sultan III. Selim and Sultan II. Mahmut (Öztuna, 1990).

In Ali Bey (Enderuni-Hanende)'s similarity, Rakım Elkutlu leads with 0,81 weight. When we analyzed our data, there was no visible links between Ali Bey and Rakım Elkutlu. Therefore, we checked the biography of Rakım Elkutlu in Öztuna (1990), and then we saw the reason of this high similarity ratio. It is given in his biography that Rakım Elkutlu took lessons from Aziz Efendi, who is not among our 99 composers. In fact, Aziz Efendi was student of Zekai Dede whom teacher Dellalzade. It is known that teacher of Ali Bey is Dellalzade. Eventually, this result sheds light on high similarity between Ali Bey and

Rakım Elkutlu. In second most similar composer to Ali Bey is Mahmut Celaleddin Paşa with 0,75 weight. We know that Dellalzade is the teacher of Mahmut Celaleddin Paşa. Therefore, the similarity result is not surprising.

When Ali Rıza Şengel (Eyyubi)'s similarity is analyzed, we saw that Muallim İsmail Hakkı Bey is the most similar to him with 0,74 weight. This finding is highly reasonable because Muallim İsmail Hakkı Bey is the teacher of Ali Rıza Şengel (Eyyubi).

In Ali Rifat Çağatay's similarity, Münir Nurettin Selçuk is most similar to him with 0,76 weight. Münir Nurettin Selçuk was one of the founder members of Şark Musiki Cemiyeti where Ali Rifat Çağatay was in charge and also a founder member. Relation among them may show this similarity ratio.

In Ali Şirügani (Dede)'s similarity, Hüseyin Sebilci is most similar to him with 0,52 weight. Then, Sadettin Kaynak comes with 0,49 weight. It is seen that the ratios are not high. We did mention why Ali Şirügani (Dede) differed from network before. He composed near 100 piece and semai and İlahi, Tevşih, Durak, Nat, Savt, and Şugl more than 600. There is no composer who composed religious music at this number (Öztuna, 1990). We have to mention that Hüseyin Sebilci and Sadettin Kaynak are Hafızs. Hafiz is called to whom knows the Quran by heart. We can say that the similarity ratio is not high the tendency of Ali Şirügani to religious music. It can be interpreted that Hüseyin Bey and Sadettin Bey are more similar to Ali Şirügani because of their tendency since they both composed in the style of religious and non-religious music.

In Arşak Çömlekciyan's similarity, Rakım Elkutlu leads with 0,87. When we analyzed their works, we saw that Rakım Elkutlu did compose in all maqams which are used by Arşak Çömlekçiyan except 'Sultani Yegah'. Besides, Rakım Bey used every tempo which is used by Arşak Bey. Since cosine similarity checks also the using density of maqams and tempos, the ratio is not close to 1. This analysis clarifies the similarity. Then, the second most similar to Arşak Çömlekçiyan is Tatyos Efendi with 0,87 weight. We know that Tatyos Efendi is the teacher of Arşak Bey. Therefore, this outcome is not shocking; on the contrary it is expected. Also, we must touch on the nationalities of Tatyos and Arşak Bey. They are both Armenian.

In Artaki Candan's similarity, Mısırlı İbrahim Efendi (Udi) is the most similar to him with 0,88 weight. We know that they worked in the same place (Yener, 2019). In the second similar to Artaki Bey is Sahak Hocasar (Kemani) with 0,85 weight. The result is reasonable since Selanikli Ahmet Efendi was the teacher of Artaki and Sahak Beys.

In Asdik Ağa's similarity, Tatyos Efendi is the most similar to him with 0,86 weight. The reason of this is that Tatyos Efendi was the student of Asdik Ağa. Besides, we must add that they are both Armenians.

In Bolahenk Nuri Bey's similarity, Neyzen Rıza Bey leads with 0,74 weight. The outcome is expected since Bolahenk Nuri Bey is the teacher of Neyzen Rıza Bey. The second most similar to Bolahenk Nuri Bey is Nikoğos Ağa with 0,70 weight. We have to clarify that Dellalzade is the teacher of Bolahenk Bey and Nikoğos Ağa. For this reason, the result is not unexpected.

Dramalı Hasan Hasgüler is similar to Münir Nurettin Selçuk with 0,80, Musa Süreyya with 0,79, Refik Fersan with 0,79, Sadettin Kaynak with 0,79, and Hüseyin Sebilci with 0,77 weights in order. In our data, Dramalı Hasan Hasgüler had no connection with any composers. Therefore, we deduced that they are similar to each other since they are the composers of the same period. It is highly possible that a composer can be influenced from another composers who lived in the same period.

In Dürri Turan's similarity, it is found that Suphi Ziya Özbekkan is the most similar to him with 0,73 weight. When we looked at their teachers, we saw that Tanburi Cemil Bey taught both of them. The second most similar to Dürri Turan is Zekai Dede with 0,73 weight. Another teacher of Dürri Turan is Ahmet Irsoy (Hafız-Zekaizade), who is the son and student of Zekai Dede. Hence, the outcome makes sense. The third most similar to Dürri Bey is Refik Fersan with 0,72 weight. Refik Fersan is the student of Tanburi Cemil Bey.

Ebu-Bekir Ağa is most similar to Tabi Mustafa Efendi with 0,67 weight. It is seen that ratio is not high. When we look for a link between these composers, we showed that Ebu-Bekir Ağa lived between 1685 and 1799 and Tabi Mustafa Efendi lived between 1703 and

1774. It can be deduced that they are similar to each other since they lived in the same period.

Giriftzen Asım Bey is similar to Hafız Yusuf Efendi with 0,83, Şevki Bey with 0,80, Medeni Aziz Efendi with 0,79, Hacı Arif Bey with 0,78, Şemsettin Ziya Bey with 0,77, and Ahmet Rasim Bey with 0,77 weights in order. In Öztuna (1990), it is given that, Giriftzen Asım Bey took advantage of masters like Hacı Arif Bey, Zekai Dede, Tanburi Ali Efendi, Medeni Aziz Efendi, and Bolahenk Nuri Bey. Also, Tanburi Cemil Bey is a friend of him. Moreover, Şevki Bey is the student of Hacı Arif Bey. Furthermore, Şemsettin Ziya Bey is a student of Tanburi Cemil Bey. Ahmet Rasim Bey is the student of Zekai Dede. These knowledges explain the similarity in here except Hafız Yusuf Efendi.

In Hacı Faik Bey's similarity, Muallim İsmail Hakkı Bey leads with 0,81 weight. In second, Hacı Arif Bey comes with 0,79 weight. Hacı Faik Bey followed the Ecole of Hacı Arif Bey, who is a fellow of him, and influenced from him. Also, İsmail Hakkı Bey took lessons from Zati Arca who is not among our 99 composers data. But, it is important to indicate that Zati Arca was a student of Hacı Arif Bey.

Hafız Hüsnü Efendi (Enderuni) is most similar to Münir Nurettin Selçuk with 0,67 weight. The reason of similarity may be explained as Hüsnü Efendi is Hafız and Münir Bey is raised by two Hafızs in his music education. This might be the reason of their similarity since they came similar cultural and traditional past.

Hafız Post is most similar to Tabi Mustafa Efendi with 0,67 weight. Hafız Post lived between 1630 and 1694 and Tabi Mustafa Efendi lived between 1703 and 1774. The closeness of their periods may be the answer of their similarity.

Hamparsum Limoncuyan is most similar to Dede Efendi with 0,73 weight. He is the student of Dede Efendi. Then, in second Dellalzade who is a student of Dede Efendi comes with 0,67 weight. In the third, Hamparsum Bey is similar to Zekai Dede, who is a student of Dede Efendi and Dellalzade, with 0,66 weight. In fourth, Hamparsum Bey is similar to Şakir Ağa who is the student of Dede Efendi, with 0,65 weight. In here, the effect of Dede Efendi can be seen clearly.

Haşim Bey is most similar to Suyolcuzade Salih Efendi with 0,68, İsmet Ağa with 0,67, and Dede Efendi with 0,67 weights in order. Moreover, Dede Efendi is the teacher of both Haşim Bey and Salih Efendi. We know that Haşim Bey lived between 1814 and 1868. Year of birth of İsmet Ağa is not known, but he died in 1870. They were both raised in Enderun and worked at the Palace. Therefore, their similarity is reasonable. It is also possible that Dede Efendi might have influenced them.

Hüseyin Sadettin Arel is most similar to Muallim İsmail Hakkı Bey with 0,44 weight. Then, in the second, he is similar to Suphi Ezgi with 0,43 weight. It is known that Hüseyin Bey and Suphi Bey are close friends and worked together. Even so, similarity ratios are pretty low.

Hüseyin Sebilci is most similar to Sadettin Kaynak with 0,79 weight. Hüseyin Bey lived between 1894 and 1975 and Sadettin Bey lived between 1895-1961. Also, they are both Hafız. As it is seen, they both lived in the same period. They may be influenced from each other.

Itri (Buhurizade Mustafa Efendi) is most similar to Abdülkadir-i Meragi with 0,64 weight. Meragi and Itri are one of the most famous composers in classical Turkish music (Öztuna, 1990). As previously detailed, Itri might have been influenced by Meragi because they are in the same the Meşk sequence.

İsak Varon is most similar to Mısırlı İbrahim Efendi (Udi) with 0,85 weight. They are both Jews. Moreover, İsak Varon lived between 1884 and 1962. Similarly, İbrahim Efendi lived between 1872 and 1933. The reason of high similarity ratio may be the interactions belong to their nations and the period.

İsmet Ağa is most similar to Nikoğos Ağa with 0,73 and Numan Ağa with 0,70 weights in order. Birthdate of İsmet Ağa is not known, but he died at 1870. Similarly, Nikoğos Ağa lived between 1820 and 1890. But, Numan Ağa lived between 1750 and 1834. As it is seen, they are almost the composers of the same period. Also, they are all called ‘Ağa’ since their position in the Enderun. They may have been influenced by each other.

İzzettin Hümayi Elçioğlu is most similar to Muallim İsmail Hakkı Bey with 0,55 weight. The outcome is not surprising since İzzettin Bey is the student of İsmail Hakkı Bey. But, it is remarkable that the similarity ratio is not high.

Kanuni Hacı Arif Bey is most similar to Mustafa Sunar with 0,77 weight. Then, in second Artaki Candan comes with 0,77 weight. In the third, he is similar to Civan Ağa with 0,74. There are no visible links between these composers.

Kanuni Nazım Bey (1884-1920) is most similar to Rakım Elkutlu (1869-1949) with 0,77, Arşak Çömlekçiyan (1880-1930) with 0,74, and Bimen Şen (1873-1943) with 0,73 weights. As it is seen; all of the composers lived in the same period.

Kaptanzade Ali Rıza Bey (1881-1934) is most similar to Yesari Asım Arsoy (1900-1992) with 0,72 and Sadettin Kaynak (1895-1961) with 0,70 weights. They lived in the same periods. It can be deduced that their similarity might have occurred for this reason.

Kazasker Mustafa İzzet Efendi is most similar to Dede Efendi with 0,69 weight. As a matter of fact, Teacher of İzzet Efendi is Şakir Ağa who is the student of Dede Efendi.

Kazım Uz (Muallim) is most similar to Zekai Dede with 0,75 weight. There is a high similarity ratio between them since he is the student of Zekai Dede.

Kemani Rıza Efendi (1782-1852) is most similar to Numan Ağa (1750-1834) with 0,74 and Dede Efendi (1778-1846) with 0,70 weights. We can only say that they all lived in the same period.

Kemani Serkis Efendi is most similar to Selanikli Ahmet Efendi with 0,71 weight. It is known that Selanikli Ahmet Efendi is the teacher of two Armenian composers that are Artaki Candan and Sahak Hocasar (Kemani). Besides, Serkis Efendi is Armenian. Hence, we may reason the similarity may have occurred with the interaction of Armenian composers.

Klarnetçi İbrahim Efendi (Unknown-1925) is most similar to Hafız Yusuf Efendi (1858-1919) with 0,71, Artaki Candan (1885-1948) with 0,71, and Bimen Şen (1873-1943) with 0,70 weights. It can be deduced that the similarities among them may have occurred since their periods.

Kömürcüzade Mehmet Efendi H. is most similar to Şakir Ağa with 0,73, Numan Ağa with 0,70, Sultan II. Mahmut (Adli) with 0,69, and Dede Efendi with 0,68 weights. Moreover, Mehmet Efendi is friend with Numan Ağa and Dede Efendi and have connection with Sultan III. Selim (İlhami). Furthermore, Şakir Ağa is the student of Dede Efendi. Sultan II. Mahmut learned music from Sultan III. Selim. Also, they all lived in the same period. With all this information, the similarity among them is not surprising.

Latif Ağa is most similar to Sultan II. Mahmut (Adli) with 0,73 weight. As a matter of fact, Latif Ağa was raised in Enderun, and then worked in Enderun in the time of Sultan II. Mahmut. The reason of similarity might have occurred from this case. In the second, he is similar to Muallim İsmail Hakkı Bey, who is the student of him, with 0,72.

Latif Efendi is most similar to Medeni Aziz Efendi with 0,81 weight.

Lavtacı Hristo is most similar to Tatyos Efendi with 0,75 weight. The reason of the similarity is that the brother of Lavtacı Hristo is Civan Ağa, who is the teacher of Tatyos Efendi.

Mahmut Celaleddin Paşa is most similar to Hacı Arif Bey with 0,77, Ali Bey (Enderuni-Hanende) with 0,75, and Rakım Elkutlu with 0,74 weights in order. The teacher of Mahmut Celaleddin Paşa and Ali Bey is Dellalzade. Hacı Arif Bey is the student of Dede Efendi and Zekai Dede. Also, Rakım Elkutlu took music lessons from Aziz Efendi (He is not among our 99 composers) who was a student of Zekai Dede. As previously mentioned, Dellalzade is the student of Dede Efendi and the teacher of Zekai Dede. All these information clarifies the similarities above.

Markar Ağa is most similar to Kemani Rıza Efendi with 0,62, Latif Ağa with 0,61, Tanburi Mustafa Çavuş with 0,61, Numan Ağa with 0,60, and Şakir Ağa with 0,60 weights in order.

Medeni Aziz Efendi (1842-1895) is most similar to Hafız Yusuf Efendi (1857-1925) with 0,82, Latif Efendi (Unknown-1910) with 0,81, and Giriftzen Asım Bey (1851-1929) with 0,79 weights in order. Giriftzen Asım Bey is the student of Medeni Aziz Efendi. There is no information about other composers, but we can deduce that they may be similar since they lived in nearly same periods.

Mehmet Yürü (Nasibin) (1882-1953) is most similar to Bimen Şen (1873-1943) with 0,85 weight. There is no information about the connection between them. But, the ratio is remarkably high. In Öztuna (1990), they are both presented as 'Turk Song Composer'. Bimen Şen might have influenced Mehmet Yürü since he was a highly popular composer. Moreover, Hacı Arif Bey had gone to Bursa to listen Bimen Şen, and taught some compositions to him and advised to him to go to İstanbul to improve his skills. Furthermore, Bimen Şen had taken advantage of Rahmi Bey and Şevki Bey, who are the most prominent of song form and followers of Hacı Arif Bey, with listening them. Also, it is remarkable that the Romantic Ecole in classical Turkish music had started with Hacı Arif Bey. The main importance of this Ecole is that song form had taken the place of classical forms with long lyrics (Öztuna, 1990).

Mısırlı İbrahim Efendi (Udi) is most similar to Artaki Candan with 0,88 weight. As we mentioned before, they worked in the same place. In the second, He is similar to İsak Varon with 0,85 weight. The high ratio of similarity between İbrahim Efendi and İsak Varon might have occurred in the interaction of national since they are both Jews.

Muallim İsmail Hakkı Bey is most similar to Hacı Faik Bey with 0,81 weight. They may be similar since they both composed lots of work on extravaganza which is freestyle music. In extravaganza, the rules of song forms are not followed. In the second most similar to İsmail Hakkı Bey is Dede Efendi with 0,80 weight. In third most similar to him is Refik Fersan with 0,80.

Muhlis Sabahattin Ezgi is most similar to Civan Ağa with 0,74 and Şekerci Cemil Bey with 0,73 weights.

Musa Süreyya Bey (1884-1932) is most similar to Dramalı Hasan Hasgüler (1896-1984) with 0,79, Civan Ağa (Unknown-1910) with 0,77, and Refik Fersan (1893-1965) with 0,77 weights. The similarity may have occurred since they lived in nearly the same period except Civan Ağa.

Mustafa Sunar is most similar to Artaki Candan with 0,81.

Münir Nurettin Selçuk is most similar to Dramalı Hasan Hasgüler with 0,80, Refik Fersan with 0,77, Muallim İsmail Hakkı Bey with 0,77, and Ali Rifat Çağatay with 0,76 weights. The only connection it is found among composers in here is that Münir Bey and Ali Rifat Bey are friends.

Nesim Silviya (Haham) is most similar to Neyzen Ali Rıza Efendi (Şeyh) with 0,70 weight. In second, Nesim Silviya is similar to Zekai Dede with 0,56 weight. In the third, He is similar to Udi Sami Bey with 0,55 weight. It is remarkable that there is quite a few differences between the first similar and the second similar composer to Nesim Silviya.

Neyzen Rıza Bey is most similar to Bolahenk Nuri Bey, who is the teacher of him, with 0,74 weight. In second, Hacı Arif Bey comes with 0,74 weight. In the third, Hacı Faik Bey comes with 0,73 weight. As we mentioned before, Dede Efendi, Zekai Dede and Haşim Bey were the teachers of Hacı Arif Bey. Moreover, Dellalzade is the most favored student of Dede Efendi. Furthermore, Dellalzade and Haşim Bey were the teachers of Bolahenk Nuri Bey. Besides, Hacı Faik Bey is the student of Dellalzade and Haşim Bey. They all are connected in somehow. The outcome here is not surprising.

Nikoğos Ağa is most similar to Numan Ağa with 0,80 weight. Then, Şakir Ağa and İsmet Ağa comes with 0,75 and 0,73 weights. It is known that Nikoğos Ağa and Şakir Ağa are the students of Dede Efendi. Also, Numan Ağa and Dede Efendi know each other.

Numan Ağa is most similar to Şakir Ağa with 0,83 weight. Above their connection is given. Then, Nikoğos Ağa and Dellalzade comes with 0,80 and 0,76. Also, it is remarkable that Nikoğos Ağa is the student of Dellalzade.

Osep Ağa is most similar to Zekai Dede with 0,64 weight. As a matter of fact, Osep Ağa is the student of Levon Hancıyan who is not among in our data of 99 composers. It is significant that Zekai Dede is the teacher of Levon Hancıyan.

Rahmi Bey is most similar to Hacı Arif Bey with 0,77 weight. We mentioned before that Rahmi Bey is a follower of Hacı Arif Bey and his Ecole.

Rakım Elkutlu is most similar to Şerif İçli with 0,90, Hacı Arif Bey with 0,87, and Arşak Çömlekçiyan with 0,87 weights in order. Moreover, Rakım Elkutlu took advantage of Aziz Efendi, who is the student of Zekai Dede. Also, it is indicated in Öztuna (1990) that Rakım Elkutlu had composed in every sort of music. It may be the reason; he gets high similarity ratios with many composers.

Refik Fersan is most similar to Hacı Arif Bey with 0,81 weight. In the second, he is similar to Muallim İsmail Hakkı Bey with 0,80 weight.

Sadettin Kaynak is most similar to Yesari Asım Arsoy with 0,87 weight. Then, he is similar to Hüseyin Sebilci (Hafız) with 0,79 weight.

Sadi Işılay is most similar to Sadettin Kaynak with 0,76 weight. Then, he is similar to Yesari Asım Arsoy with 0,76 weight.

Sahak Hocasar (Kemani) is most similar to Artaki Candan with 0,85, İsak Varon with 0,84, and Mısırlı İbrahim Efendi with 0,84 weights in order. It is remarkable that Selanikli Ahmet Efendi is the teacher of Sahak and Artaki Beys.

Santuri Ethem Efendi is most similar to Hacı Arif Bey with 0,71 weight. It is important to indicate that Ethem Efendi is the student of Hacı Arif Bey.

Selanikli Ahmet Efendi is most similar to Asdik Ağa with 0,82, Bimen Şen with 0,80, Tatyos Efendi with 0,79, and Artaki Candan with 0,79 weights. As it is indicated, Selanikli Ahmet Efendi is the teacher of Sahak and Artaki Beys. Also, all of the composers in here are Armenians except Ahmet Efendi.

Sultan II. Mahmut (Adli) is most similar to Dellalzade with 0,77, Şakir Ağa with 0,76, Ali Ağa (Kemani) with 0,76, Ahmet Irsoy (Hafız-Zekaizade) with 0,75, and Dede Efendi with 0,74 weights. The effect of Dede Efendi is highly obvious in here. We remarked the links of before, we only did not mention Dede Efendi had already the title of 'Favorite of Sultan' by Sultan II. Mahmut. Also, it is known that Ali Ağa had taken Sultan's courtesy (Öztuna, 1990).

Sultan III. Selim (İlhami) is most similar to Dellalzade with 0,70, Numan Ağa with 0,63, Dede Efendi with 0,63, Sultan II. Mahmut (Adli) with 0,62, and Zekai Dede with 0,61 weights. It is clear that the influences of Dede Efendi are valid in here.

Suphi Ezgi is most similar to Suphi Ziya Özbekkan with 0,57, Muallim İsmail Hakkı Bey with 0,57, Dürri Turan with 0,56, and Rahmi Bey with 0,56 weights. We must indicate that the similarity ratios are not high.

Suphi Ziya Özbekkan is most similar to Rakım Elkutlu with 0,83, Şevki Bey with 0,82, Ahmet Rasim Bey with 0,81, and Hacı Arif Bey with 0,79 weights. Moreover, Suphi Ziya Bey is the student of Ali Rifat Bey and Tanburi Cemil Bey. Ali Rifat Bey is the student of Ahmet Irsoy (Hafız-Zekaizade). Furthermore, Rakım Bey is the student of Tanburi Ali Efendi, who is the teacher of Cemil Bey. Ahmet Rasim Bey is the student of Zekai Dede. Besides, Şevki Bey is the student and follower of Hacı Arif Bey. All things considered, similarities gain meaning.

Suyolcuzade Salih Efendi is most similar to Dellalzade with 0,73 and Lavtaco Hristo with 0,70 weights. Then, he is similar to Asdik Ağa with 0,69, Haşim Bey with 0,68, and Dede Efendi with 0,68 weights. Moreover, Dede Efendi is the teacher of Salih Efendi, Dellalzade, and Haşim Bey as it is indicated before. Furthermore, Dellalzade is the teacher of Haşim Bey.

Şakir Ağa is most similar to Numan Ağa with 0,83 weight. Dede Efendi is the teacher of Şakir Ağa, also has connection with Numan Ağa. Similarity is reasonable in here.

Şekerci Cemil Bey is most similar to Hacı Arif Bey with 0,84 weight. Then, he is similar to Bimen Şen with 0,84 and Civan Ağa with 0,82 weights.

Şemsettin Ziya Bey is most similar to Giriftzen Asım Bey with 0,77 weight. Then, he is similar to Bimen Şen with 0,76 and Tanburi Cemil Bey with 0,75 weights. Moreover, Ziya Bey is the student of Cemil Bey. Furthermore, Asım Bey and Cemil had also connection.

Şerif İçli is most similar to Rakım Elkutlu with 0,90 and Tatyos Efendi with 0,89 weights. Şerif İçli had followed the style of Şevki Bey (Öztuna, 1990). We also know that Şevki Bey and Tatyos Efendi had a connection. The influence may have occurred from this link.

Şevki Bey is most similar to Arşak Çömlekçiyan with 0,87, Ahmet Rasim Bey with 0,86, and Rakım Elkutlu with 0,83 weights. We mentioned above the connection of Şevki Bey and Tatyos Bey. We should also indicate in here that Tatyos Efendi is the teacher of Arşak Bey. The similarity result is not surprising at all.

Şükrü Şenozan is most similar to Dürri Turan with 0,60, Zekai Dede with 0,59, and Münir Nurettin Selçuk with 0,59 weights. We should indicate that the similarity ratios are not high in here. Şükrü and Dürri Beys had two teachers in common. Those two teachers are Ali Bey (Enderuni-Hanende) and Ahmet Irsoy (Hafız-Zekaizade). Moreover, Zekai Dede is the teacher of Şükrü Bey. Furthermore, Ahmet Irsoy is the teacher of Münir Nurettin Bey. In here, the effect of Zekai Dede can be seen obviously. Naturally, the effect of Dede Efendi is revealed.

Tabi Mustafa Efendi (1703-1774) is most similar to Hafız Post (1630 - 1694) with 0,67 and Ebu-bekir Ağa (1685-1799) with 0,67 weights. As it is seen, their periods are closer to each other. The similarity can be interpreted as the effect of Hafız Post since he is older than other two composers.

Tanburi Ali Efendi is most similar to Rakım Elkutlu with 0,75, Muallim İsmail Hakkı Bey with 0,75, and Hacı Faik Bey with 0,74 weights. Moreover, Rakım Bey is the student of Ali Efendi. Furthermore, Latif Ağa is the teacher of Ali Efendi and İsmail Hakkı Bey.

Tanburi Cemil Bey is most similar to Bimen Şen with 0,76 and Şemsettin Ziya Bey with 0,75 weights. Besides, Kanuni Hacı Arif Bey had a connection with Bimen Şen and Cemil Bey. Therefore, Kanuni Hacı Arif Bey may be the link between them. Moreover, Şemsettin Ziya Bey is the student of Cemil Bey.

Tanburi İzak Efendi is most similar to Zekai Dede with 0,58 weight. It is important to mention that the similarity ratio is not high in here.

Tanburi Mustafa Çavuş is most similar to Suphi Ziya Özbekkan with 0,74 and Denizoğlu Ali Bey with 0,72 weights.

Tatyos Efendi is most similar to Şerif İçli with 0,89, Arşak Çömlekçiyan with 0,87, Asdik Ağa with 0,86, and Rakım Elkutlu with 0,85 weights. Moreover, Tatyos Efendi is the teacher of Arşak Bey. Furthermore, Asdik Ağa is the teacher of Tatyos Efendi. Besides, these three composers are Armenian.

Udi Sami Bey is most similar to Mustafa Sunar with 0,75 weight. Then, he is similar to Münir Nurettin Selçuk with 0,65 weight. We should indicate that there is a big difference between two similar values. Moreover, Udi Sami Bey is the student of Zekai Dede. Furthermore, Mustafa Sunar and Münir Bey are the students of Ahmet Irsoy (Hafız-Zekaizade). In here, the effect of Zekai Dede is obvious.

Yesari Asım Arsoy (1900-1992) is most similar to Sadettin Kaynak (1895-1961) with 0,87 weight. Öztuna (1990) declared that both of them as Turk Song and Extravaganza Composers. Also, their periods are same. The reason of the similarity may be their tendencies in the same period.

Zaharya is most similar to Dede Efendi with 0,64, Bimen Şen with 0,63, and Medeni Aziz Efendi with 0,63 weights. It is important to mark that similarity ratios are low in here.

Zekai Dede is most similar to Dede Efendi with 0,80 weight. Then, he is similar to Muallim İsmail Hakkı Bey with 0,78, Ahmet Irsoy with 0,75, Kazım Uz (Muallim) with 0,75, and Dellalzade with 0,74 weights. We have mentioned the links of the above composers before. As we mentioned before, Zekai Dede is the student of Dede Efendi and Dellalzade, also he is the teacher of Kazım Uz and Ahmet Irsoy. The similarity result in here is highly important since it showed the greatest effect of the composer-teacher and composer network in classical Turkish music.

Zeki Arif Ataergin is most similar to Selanikli Ahmet Efendi with 0,65 and Rahmi Bey with 0,65 weights. It must be regarded that similarity ratios are not high in here.

Additionally, it should be mentioned that maqams which were found by Dede Efendi are Araban-Kürdi, Hicaz-Buselik, Saba-Buselik, Nev-Eser, and Sultani-Yegah. These maqams are used 74 times by composers in our data. Also, Hacı Arif Bey found Kürdilihicazkar maqam that is used by 239 times by composers. Besides, it should be indicated that Kürdilihicazkar maqam is the 5th rank in the number of use Table 17. As it is seen, they had only not composed and taught, but also contributed to classical Turkish music with finding new maqams.

In the light of the results above, we determined the prominent composers of classical Turkish music. The period, which the composer lived is an important factor. We cannot equate a composer who lived in the 14th century and 19th century. Therefore, it is better to analyze the improvements in classical Turkish music with centuries. The results of this research show that Meragi (1353-1435) was the prominent composer between 14th and 17th century until Hafız Post (1630-1694) and Itri (1640-1711). Itri is the student of Hafız Post, but he surely surpassed his teacher and contributed classical Turkish music at an extreme level. Itri was prominent between 17th and 18th century. After the genius Itri, the influence of Dede Efendi (1778-1846) is pretty tangible. Dede Efendi was one of the prominent of the 19th century. Also, we must add that the students of Dede Efendi, like Dellalzade, Zekai Dede etc., had pulled their weight, and they transmitted knowledge which is passed by his teacher with the Meşk in the classical Ecole. When the Romantic Ecole is taken into consideration, Hacı Arif Bey (1831-1885) is the highly prominent composer of the 19th century. Öztuna (1990) presents Hacı Arif Bey as ‘The Greatest Song Composer in Turkish Music’. His innovative and productive approach in the start of the

Romantic Ecole enlightened the way for his follower genius composers like Şevki and Rahmi Beys and great composers Suphi Ziya Özbekkan, Selanikli Ahmet Efendi, Bimen Şen, etc. (Öztuna, 1990).

CHAPTER 5

CONCLUSIONS

The answers to the research questions are discussed below.

- The periods when composers lived affected their relationships. For example, the influence of Dede Efendi on his students was broadly tangible in his lifetime. Although Itri and Hafız Post were in the second and third positions in Meragi's maqam and tempo similarities, the measures were not high when the Meşk sequence is taken into consideration. The measures showed there are influences among them, but the period differences among Meragi and the other two composers decreased the measures. New maqams and tempos were invented in the periods among them. Accordingly, classical Turkish music improved. Therefore, it is deduced that the periods when the composers lived are important indicators in revealing influences.

- Istanbul is the most important location for classical Turkish music composers. In our analysis of the locations of composers, it is seen that Istanbul ranks first by far for classical Turkish music. The main reason for this result is the school and workplace opportunities in Istanbul. Enderun, Mehterhane-yi Hümâyûn, Muzıkay-ı Hümâyûn, the most important Mevlevihanes, and other popular music schools were in İstanbul. In these schools, composers also worked as teachers to earn their keep.

- Geographic clustering of classical Turkish music composers was important to them. We mentioned earlier the importance of Istanbul to classical Turkish music composers. Most of the composers in our study were born in Istanbul. Some of them moved to Istanbul. For example, Hacı Arif Bey went to Bursa to listen to Bimen Şen when Bimen was a child and suggested he go to Istanbul to get a better education (Öztuna, 1990). Thus, composers clustered in Istanbul to benefit from its opportunities to become a successful composer.

- Enderun, Muzıkay-ı Hümâyûn, and Mevlevihanes were the most important schools in classical Turkish music. The result makes sense since the prominent composers were raised in these places. Enderun, Palace Muezzin, Darul Musikii Osmani, Muzıkay-ı Hümâyûn, and Mevlevihanes were the top-ranked most significant workplaces.

- The nationalities of the composers partially affected their influences. The analysis of the Armenian Arşak Bey showed that Tatyos Efendi, also an Armenian, is the second most similar to him, noting that Tatyos Efendi was Arşak Bey's teacher. Moreover, in the analysis of Asdik Ağa, his student Tatyos is the most similar to him. Furthermore, among Jews İsak Varon is most similar to Mısırlı İbrahim Efendi. Conversely, in the analysis of Nesim Silviya, there were no Jews among the top three rankings. These results show that influences among composers who are from the same nationality exist, but not always at a high level.

- Composers were influenced by their teachers and networks. In the analysis of similarity among composers, it is determined several times that influence among composers originated from their relationships. For instance, the influences of Dede Efendi and his students was highly remarkable. Many composers with relationships with Hacı Arif Bey are influenced by him.

- The most prominent composers of classical Turkish music in their lifetimes were Meragi, Itri, Dede Efendi, and Hacı Arif Bey. The influence of Meragi to Itri is shown with similarity ratios in the analysis and the Meşk sequence between them proved influential among them. As well, the influence of Dede Efendi and Hacı Arif Bey was extremely important for other composers who followed their ways.

First and foremost, maqam and tempo similarities among composers showed their social networks and influences. The analysis in this research shows the influence of composers among each other.

Maqams and tempos used by composers are chosen to research the similarities among composers because these parameters formed the structure of a composition in a frame of certain rules. These parameters are at the core of classical Turkish music, since they transmitted a work by one composer to an another. By using the approach of maqam and tempo similarity, it is expected to find that similarities show the influences among composers. In the result of the analyses, it is seen that the results matched our expectations significantly. Furthermore, revealing and analyzing the periods, locations, schools, workplaces, and nationalities of the composers helped the interpretation of the analyses effectively. In this study, the influences among classical Turkish music composers is analyzed, practiced, revealed, and interpreted. Social network analysis of the 99 classical Turkish music composers born in the Ottoman Empire before 1901 showed the relationships and influences among them and confirmed information found in Öztuna (1990) using a maqam and tempo similarity approach. These analyses showed the influences among composers that is not included in the encyclopedia of Öztuna (1990) and opened a way for researchers who are interested in the influences among composers. Furthermore, these analyses presented information about the influences among composers for music lovers.

A primary limitations of this study is the availability of well-structured data. It is observed in the literature review that classical music data in other research was more structured and founded on more detail. The nature of classical Turkish music data from the past was deficient, as previously detailed in the example of data of the compositions of Itri and Bach. Nevertheless, the best results were obtained in this study.

Based on these conclusions, researchers can study the influences among classical Turkish music composers by adding new indicators for revealing similarity among them by analyzing their work technically (like rhythmic pattern similarity, etc.) in more detail.

Music has been shaped throughout history by the intellectual contributions of notable, productive, and devoted composers, supporters, and audiences. One reason for the occurrence of new movements in music is that composers were excessively productive in that period. In popular movements, some composers reached the top level of excellence. Even though lots of compositions were composed in popular movements, still there is a

possibility that new great compositions can be created. But, in this case the chance of repetition of compositions is quite high. Another reason is the conditions prevalent during the periods of composition. Literature, painting, and music change over time. When a new Ecole occurred, follower artists had the opportunity to create original works more easily. This situation motivates them. The subject of the tendency of the age is valid for classical Turkish music. For example, Meragi, Itri, Dede Efendi, and Hacı Arif Bey excelled in their lifetimes. They all shaped their careers with their preferences and the tendencies of their age, and flawlessly shaped classical Turkish music as well.

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APPENDICES

APPENDIX A: LIST OF MAQAMS

Acem

Acem Buselik

Acem Kürdi

Acemaşiran

Aksak

Araban

Araban Buselik

Arazbar

Arazbar Buselik

Aşkefza

Bayati

Bayati (Uşşak)

Bayati Araban Buselik

Bayati Buselik

Bayatiaraban

Bayati-Bus.-Mahur

Beste Isfahan

Bestenigar

Buselik

Buselik Aşiran

Büzürg

Canfeza

Çargah

Dilfüruz

Dilkeşhaveran

Dilnişin

Dügah

Evc

Evc Buselik

Evc Huzi

Evcara

Evc-Maye

Ferahfeza

Ferahnak

Ferahnak(Evc)

Ferahnüma

Gerdaniye

Gerdaniye Buselik

Gerdaniye Kürdi

Gülizar

Heftgah

Hicaz

Hicaz (Hümayun)

Hicaz (Uzzal)

Hicaz (Zirgüleli)

Hicaz Aşiran

Hicaz Buselik

Hicaz Zemzeme

Hicaz-Buselik

Hüseyni

Hüseyni Aşiran

Hüseyni Aşiran(Gülizar)

Hüseyni Buselik

Hüseyni Kürdi

Hüseyni Zemzeme

Hüseyni-Uşşak

Hüzzam

Hüzzam (Segah)

Hüzzam(N.Zirgülede)

Hüzzam(Nim Hicazda)

Hüzzam-ı Cedid

Hüzzam-Mahur

Irak

Isfahan

Isfahanek

Karc.-Zirgüle-Hicaz

Karcığar

Karcığar(Uşşak)

Karcığar-Gülizar

Kuçek

Kürdi

Kürdi (Fada)

Kürdi-Acem Aşiran

Kürdilihicazkar

Lalegül

M. Kürdi

Mahur

Mahur Buselik

Mahur-Hicazkar

Mahur-Nihavend

Mahur-Segah-Rast

Maye

Maye (Segah)

Maye (Uşşak-Segah)

Muhayyer

Muhayyer Buselik

Muhayyer Kürdi

Muhayyer Sünbüle

Muhayyer(Tahir)

Muhayyer-Buselik

Muhayyersümbüle

Müstear

Neva

Neva Buselik

Neva-Kürdi

Neva-Nikriz

Neveser

Nevruz

Nihavend

Nihavend (Çargahta)

Nihavend-Hicaz

Nihavend-i Kebir

Nikriz

Nikriz (Yegahta)

Nikriz (Zavil)

Nişaburek

Nühüft

Pençgah

Pesendide

Rahatülervah

Rast

Rast (Nevada)

Rast (Nişaburek)

Rast (Rehavi)

Rast-ı Cedid

Rast-Nihavend

Rehavi

Reng-i Dil

Revnaknüma

Ruhnevaz

Ruy-i Irak

S.Yeg.-Bus.-A.Aşiran

S.Yegah

S.Yegah A.Aşiran

Saba

Saba (Buselikte)

Saba Buselik

Saba Zemzeme

Saba-Buselik

Sazkar

Segah

Segah (Çargahta)

Segah Araban

Segah Maye

Selmek

Sipihr

Sultan-ı Cedid

Sultani Buselik

Sultani Hüzzam

Sultani Irak

Sultani Yegah

Suzidil

Suzidilara

Suzinak

Suzinak-Nihavend

Sünbüle

Ş.Ar.-Nikriz-Mahur

Şedaraban

Şehnaz

Şehnaz Buselik

Şehnazbuselik

Şehnaz-Hüseyni

Şerefnüma

Şevkaver

Şevkefza

Şevk-i Dil

Şevkutarab

Şivenüma

Tahir

Tahir Buselik

Tarz-ı Cedid

Tarz-ı Nevin

Tebriz

Tebriz (Çargahta)

Uşşak

Uşşak(Buselikte)

Uşşak(Hicaz)

Uşşak-Hicaz

Uşşak-Mahur

Uşşak-Rast

Vech-i Arazbar

Yegah

Zavil

Zavil (Mahur)

Zevkutarab

APPENDIX B: LIST OF TEMPOS

12/8-Sofyan
Ağır Aksak
Ağır Aksak Semai
Ağır Aksak-Aksak
Ağır Aksak-Cur.
Ağır Aksak-T.Aks.
Ağır Düyek
Ağır Düyek-Sem.
Ağır Sakil
Ağır Sengin Semai
Aksak
Aksak - Sengin Semai
Aksak (Yürük)
Aksak Semai
Aksak Semai-Curcuna
Aksak-Curcuna
Aksak-Düyek
Aksak-N.Sofyan
Aksak-Semai
Aksak-Serbest
Aksak-Sofyan
Aksak-Türk Aks.
Aksak-Y.Semai
Berefşan
Ceng-i Harbi
Curcuna
Curcuna- Raks Ak.
Curcuna-Aksak
Curcuna-Düy.-Y.Sem.
Curcuna-Düyek

Curcuna-N.Sofyan

Curcuna-S.Semai

Çenber

Çenber (Ağır)

Çenber(Ağır)

Çenber-Fahte

Çifte Düyek

Çifte Sofyan

Çifte Sofyan-Y.Ak.

D. Turan-Aksak

Darbeyn

Darb-ı Fetih

Darb-ı Fetih (Ağır)

Darb-ı Türki

Değişmeli

Devr-i Hindi

Devr-i Hindi (Ağır)

Devr-i Hindi-Cur.

Devr-i Hindi-Oynak

Devr-i Kebir

Devr-i Kebir-Berefşan

Devr-i Revan

Devr-i Turan

Durak Evferi

Düyek

Düyek-Aksak

Düyek-Curcuna

Düyek-D.Hindi

Düyek-D.Revan

Düyek-Nim Sof.

Düyek-R.Aksağı

Düyek-Semai

Düyek-Serb.

Düyek-Sofy

Düyek-T. Aksağı

Evfer

Evfer (Ağır)

Evsat

Evsat-Hafif

Fahte

Fer

Firengifer

Firengifer (Ağır)

Hafif

Hafif (Ağır)

Hafif-Y.Semai

Havi

Havi (Ağır)

İkiz Aksak

Lenk Fahte

Lenk Fahte-S.Sem.

Marş

Muhammes

Müsemmen

N. Sof.-Düyek

N. Sof.-Sem.

Nim Devir

Nim Evsat

Nim Hafif

Nim Sakil

Nim Sakil-Berefşan

Nim Sof.Ser.Düy.

Nim Sofyan

Nim Sofyan-Aksak

Nim Sofyan-Düy.

Nim Sofyan-Sem.

Nim Sofyan-Semai

Oynak

Oynak(Aksak)

Oynak-Düyek

Raks Aksağı

Raksan

Remel

Remel (Ağır)

S.Semai-Y.Semai

Sakil

Semai

Semai-Düy.-Cur.

Semai-Düyek

Semai-Nim Sofyan

Semai-Sof.-T.Ak.

Semai-Sofyan

Semai-Y.Sem.

Sengin Semai

Sengin Semai (Ağır)

Sengin Semai-Curcuna

Serbest

Serbest-Sofyan

Sof.Y.Sem.-Ser.

Sofyan

Sofyan (Ağır)

Sofyan-Aksak

Sofyan-Cur.-Serb.

Sofyan-Curcuna

Sofyan-Düyek

Sofyan-N.Sofyan

Sofyan-Nim Sof.

Sofyan-Semai

Sofyan-Serbest

Şarkı Devr-i Revanı

Türk Aksağı

Türk Aksağı-Curcuna

Yürük Semai

Yürük Semai-Cur.

Yürük Semai-Sof.

Zencir