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EVALUATION OF PROSPECTIVE MATH TEACHERS' ABILITY TO ENTER GRADUATE EDUCATION WITH FUZZY LOGIC ALONG WITH VARIOUS COMPONENTS[i]

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Abstract:
It seems that getting graduate education has become more important compared to the past. This is the case for teachers and prospective teachers. In order to be admitted for graduate education in Turkey, one must have ALES (Academic personnel and graduate education entrance exam), College GPA (graduation grade point average) and a foreign language score. The road to success is a difficult process for many students to complete when represented by classification of traditional graduation grade point average. Development approaches of student achievement need to have a framework consisting of more in number and a complex success criteria in order to be more effective. Apart from the aforementioned grade data that was mainly determined in the classification that classify whether prospective teachers were suitable for graduate education or not, some other components such as; their emotional data, their level of knowledge on graduate education and how much priority they give to teaching department while doing their university preferences have also become important. The study was shaped in this context and by assessing various components related to the students with fuzzy logic, a more effective prediction and classification was tried to be presented. In the study, considering attitudes of prospective teachers towards graduate education, their genders, their levels of knowledge on graduate education, their university entrance scores, their order of preference, and their levels in undergraduate education, their suitabilities of admission to graduate education was aimed to be determined by fuzzy logic. In our study in which relationships of all above mentioned components with each other were analyzed, survey (scanning) method, of quantitative research methods, was used and the relational scanning model was preferred. In the study, the information of 390 prospective teachers who were studying at the department of primary school mathematics teaching in three different state universities and attending at formation programs but graduated from faculty of arts and sciences mathematics teaching

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department was used. MATLAB software was used for fuzzy logic analysis. In the research, a fuzzy logic rule base was created and 98 (25.1%) of the analyzed data were decided to be suitable for graduate education program. 29 (7.4%) of these prospective teachers were from the first year, 48 (12.3%) of them were from the fourth year, and 21 (5.3%) of them were from the formation group. The group with the highest percentage of prospective teachers considered to be suitable for graduate education is fourth year undergraduate students with 12.3%. The group with the lowest percentage is formation students with 5.3%. As a result of the analyses conducted by fuzzy logic providing a valid prediction and classification, the reason of fourth year prospective teachers have the highest percentage in the research can be explained as their having higher attitude scores and being more knowledge about graduate education and having higher scores on the university entrance exams than the other participants. In order to ensure prospective teachers to have a higher attitude towards the graduate education, their gaining awareness of research and being informed about graduate education from the first years of college can provide significant benefits. Prospective teachers in different departments may be included in the study. Considering different components related to the prospective teachers and conducting researches using other methods of artificial intelligence such as fuzzy logic, students and educators can be provided an effective prediction and classification opportunities.

Keywords: fuzzy logic, graduate education, attitude, classification

1. Introduction

Graduate education is becoming important for every industry in the world today. So is it for teachers. To obtain post graduate education is a significant demand in Turkey as well as all over the world. The studies related to graduate education are mostly about problems of graduate students (Chapman and Chien, 2015 Ibis, 2015 McAlpine and Norton, 2006; Humphrey and McCarthey, 1999; Johnson, 2009; Duan and Shan, 2013), online graduate education programs (Chellam Thani, 2014, Daniel Schumacher, Stelter and Riley, 2016), graduate education programs (Özbay, 2008), evaluation of graduate programs (Tosunoğlu and Kayadibi, 2007), and quality of graduate studies (Blouin and Moss, 2015 Beyreli and Arı 2008; Kaçalin, 2008).

Graduate education studies related to the student admission to graduate education are seen to have been analyzed in the studies on student and system problems and in comparative education studies. (Kubow and Blosser, 2016; McMahon and Jones, 2015 Karakütük, 2002; Humphrey and McCarthey, 1999; Lessing and Lessing, 2004; Carlozo, 2012).

When the literature is reviewed, the obtained data from the studies about teachers and prospective teachers' opinions related to graduate education, their preference reasons of graduate education and the problems they experienced during the graduate education are seemed to have been collected through questionnaires or

interviews (Konokman and Alıcı 2014, Alabaş and others, 2012; Başer and others 2005; Ünal and İlter, 2010, Yıldız, Akpınar, Aşkar and Ergin, 2005).

In the study, with reference to these studies in the literature, attitudes of prospective teachers towards graduate education, their genders, their knowledge level on graduate education, their university entrance scores, their order of preference, and their suitabilities to enter graduate education considering their grade levels of undergraduate education were analyzed with Fuzzy Logic.

This study can be considered as original, because any studies on evaluation of attitudes of prospective teachers towards graduate education with various components along with Fuzzy Logic were not found in the literature; it can also be considered as contemporary, since it will contribute to the field of evaluation with various components on attitudes of prospective teachers towards graduate education that is a rising trend in many sectors today; and it can be defined as necessary, because the evaluation which will be done by Fuzzy Logic can provide a serious alternative method to classical evaluation methods applied in the field of education; Finally, the study can also be defined as functional, since it aimed to determine whether the attitudes of prospective teachers could vary according to their grade levels, genders, level of knowledge about graduate education, university entrance scores, order of preference and their views on to graduate education.

2. Attitude

When considered that attitudes are shaped by the effects of social values and psychological intellectual formations, it is inevitable that there are different definitions. Kolasa (1979) defined attitude as; *"a positive or negative response to any people, places or events"*. Attitude is a tendency that is attributed to an individual and it forms his/her thoughts, emotions and behaviors about a psychological object on a regular basis. (Smith 1968). This definition by Smith (1968) indicates that the attitude is not a directly observable characteristics, but it is a tendency that is attributed to an individual by deducing from his/her behaviors (Cohen and Swerdlik, 2001; Anastasi and Urbina, 1997).

Attitude is one of the most important determinatives of human behaviors. It significantly affects attitudes, senses of love and senses of hate and behaviors of individuals (Morgan 1991).

It is asserted that academic achievement is related with many factors directly or indirectly. The affective features can be discussed as one of these factors. When it is considered in this regard, it can be though that affective factors like attitude, self-efficacy, motivation and anxiety will affect lots of factors firstly like the interests and aptitudes of students towards lessons and this may affect the performance accordingly academic achievements of students.

The studies on affective factors affecting academic achievement are Saral (1993), Diaz (1989), (Zvolensky and et al., 2006).

There are some other researches available on the subject indicating a positive attitude and motivation towards lessons affect academic success. These studies are Sonnert, Sadler, Sadler and Bressoud (2015), Sahin and Kisla (2016); Agbuga, Xiang and McBride (2012); Yasar (2016); Yasar (2016); Oliver and Simpson (1988), Levin, Naama ve Zippora (1991), Kan and Akbaş (2006), House and Prison (1998).

Radford and Govier (1991) state that attitudes are very hard to be observed directly, but they can be revealed by people's behaviors. One of the methods of measuring attitudes is to observe individuals' responses to a certain number of substances (Erkuş, 2003; Tavşancıl, 2006). In other words, attitudes are measured through measurement techniques. The most commonly used scaling method to measure attitudes is Likert-type scales.

3. Graduate Education

Graduate education that takes part within higher education is an education process in which researchers the community needs are raised. By now, prospective teachers can develop themselves in terms of vocational training and gain a creative and investigative identity by studying for master degree. Many conducted studies have also mentioned about the importance of graduate education. (Ramadi, Ramadi and Nasr 2016; Nasr 2014; Guzzomi, Male and Miller, 2015; Çoklar and Kılıçer, 2007, Karakütük 1999, Aslan 2007, Oğuz 2004, İpek, Şahin and Çepni, 2007). There are also some studies arguing that graduate education opportunities can be generalized for teachers in order to develop themselves (Uras and Kunt, 2005; Çepni and Küçük, 2002).

Graduate level education is the process of learning specialized knowledge about a field or discipline. When graduate level education is completed, a master's or doctorate degree is awarded. Students in these programs may also be required to complete research projects on topics like teaching strategies and student assessments. A teaching practicum may also be included to help students implement what they have learned.

Colleges with competitive admission also evaluate a candidate's grade point average and the type of degree the candidate has earned. Nearly all graduate programs are designed to teach students specialized knowledge about a specific discipline. Consequently, students who have already completed coursework that aligns with the discipline of a graduate program typically have better odds of being accepted.

Most graduate programs have several admission requirements. ALES (Academic Personnel and Graduate Education Entrance Exam) score and the average graduation score are most important components to qualify for graduate education in Turkey. ALES is an exam used to indicate the level of basic logic and reasoning skills. Therefore, majority of prospective mathematics teachers can get high scores from this examination. This is a standardized test that evaluates reading comprehension, math skills and analytical skills.

3. Attitudes of Prospective Teachers towards Graduate Education

The conducted studies revealed that the skills which prospective teachers obtained from graduate education were "*its laying a basis for academic researches, students' accessing information by scientific research, their developing evaluation and interpretation skills, their establishing good relationships with professional circles and students, their helping to solve the educational problems of environment, school and class by scientific methods*". (Alhas, 2006)

To succeed in an academic career, individuals must be in a consistent motivation and studying discipline starting from undergraduate education period. In this process, the importance of emotional factors accompanying students is great. Effects of attitude on success are considerable as in other emotional characteristics.

When teachers chose to get graduate education, their willingness of being an academic staff came first than their desires of personal development and professional career. A similar conclusion was reached in a study conducted by Başer et al. (2005) towards the teachers who were doing their masters, however his study did not show the similar results with the study conducted by Oluk and Çolak (2005) about the teachers who were doing their masters. Başer et al. (2005) reached the conclusion that 16,7% of graduate teacher students were getting graduate education for academic career. Oluk and Çolak (2005) also came to the conclusion that all teacher participants in their research were getting graduate education in order to have an academic career and to be an academic staff at universities. In the study, it was revealed that teachers were doing their masters, especially for their personal development. In their personal development related area, their desires for self-improvement, finding solutions to educational problems, scientific curiosity, competence in educational programs, following innovations and doing a minor came out.

This obtained result is similar to the findings of the study conducted by Kara (2008). Kara, in his study in which he analyzed the graduate experiences of mathematics teachers and their reflections into their school lives, came to a conclusion that mathematics teachers who were doing their masters stated that their graduate education contributed to their personal and vocational developments by providing them to gain skills such as; to follow their own field or educational developments by reading articles or newspapers online, to socialize between teachers, to help each other to develop and to have reflective thinking.

In the conducted studies, there are some studies indicating that prospective teachers and teachers have a positive attitude and willingness towards getting graduate education. (Dönmez et al., 2012; Şaşmaz, Ören et al., 2012; Köksalan et al., 2010; Ünal ve İlter, 2010; Erkılıç, 2007; Kyriacou and Kunc, 2007; Bertram, Mthiyane and Mukeredzi, 2012).

Besides these positive attitude studies, there are also studies that have negative attitudes towards getting graduate education. Doğusan (2003) identified the aspects of a total of 299 administrators and teachers towards graduate education with the help of a scale. According to the scale, general attitudes of administrators and teachers towards graduate education were negative and they also showed negative attitudes related to

graduate admission requirements, graduate education period, and after graduate period. However, the participants of the study were undecided about the importance of graduate education.

There are some studies that evaluated the attitudes of prospective teachers towards graduate education according to the components of gender, (Konokman and Alıcı, 2014; Ünal and İlter, 2010), grade level (Ören et al., 2012), and level of knowledge on graduate education (Karakütük, 2000).

There are many studies available that analyze the attitudes of prospective teachers towards graduate education in terms of various components (Senemoğlu and Özçelik, 1989; Johnson and Howell, 2005; Kara, 2008, Alabaş, 2011).

As it is seen in these studies, the effect of attitude on the success have been highlighted and it is believed to be effective in shaping academic career paths of prospective teachers.

4. Fuzzy Logic

While the decision makers make selections and predictions about the future, they usually use qualitative expressions instead of quantitative expressions expressing certainty. Thus, the decision makers sometimes have to do complicated, vague, and broad systems by using their ability to make proximate assessments which is a humanistic feature. Fuzzy Logic was proposed by Lotfi Zadeh in 1965 for modeling these kinds of complex, ambiguous and broad systems by using human logic. Fuzzy Logic reveals "invaluable logic" indicating that there is almost an infinite number of values between 0-1 against classical logic which degrades life to right or wrong like 0 and 1.

There are two basic elements in a fuzzy system: Fuzzy Sets and Rules.

With the rules defined by fuzzy sets, the system inputs are converted to the desired outputs. Inputs respectively pass the stages of fuzzification, control and defuzzification. If we show Fuzzy sets, rules and the three stages in a single structure, we can use the following table.

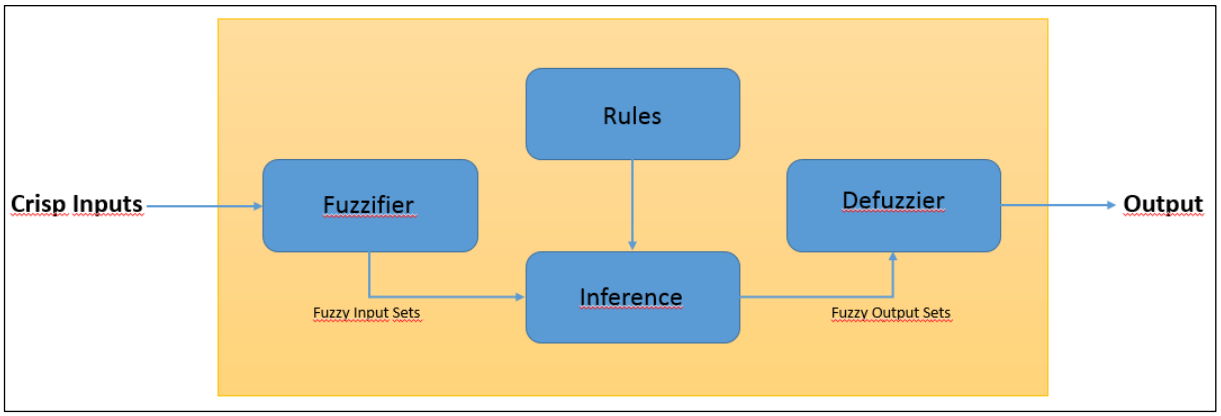


Figure 1: Diagram of Fuzzy Logic Process

The rules to be defined create a decision mechanism according to the input value. With the degrees given to the input values, the membership functions are prepared. Membership functions are used to measure the proximity of an element to a subset between [0,1]. Using available information and defined rules, the process of building a link between them and creating sets that have fuzzy values is called Fuzzification. After this stage, a fuzzy version of the desired result information emerges.

The value which is equal to the best point that the membership functions present is the solution of the problem. If the stages are reviewed again, it can be seen that fuzzy system provides the most optimal output by preparing membership functions that provide the decision-making mechanism with the variables it received from the outside, and by filtering them out from the filter of rules. Other inputs take values according to their proximity to the sets between [0,1].

Most of the studies with fuzzy logic are seen in the engineering field. Laouafi, Mordjaoui and Dib (2015) about Electric Load Forecasting Using Neuro-fuzzy System, Aloui and Grissa (2015) about Flexible Queries Using Fuzzy Ontologies, Mhalla and Benrejeb (2015) about using Manufacturing Systems with Time Constraints, Akiyama and Tsuboi (1996); Lo and Lam (1997); Henn (1997) have made studies on the field of transportation and traffic engineering, Kosko (1992) about machine and dynamical systems, Altas and Sharaf (1992), Liu (1997), Li, Lai and David (1999) about electric power. Many engineering fields which use fuzzy logic practices can be given as examples. Chen and Cheng (2005) have conducted a study in selecting personnel in information systems. Karsak (2001) used TOPSIS (a technique for order preference by similarity to ideal solution), one of the multi-criteria decision-making methods, along with fuzzy logic for the solution of personnel selection problem. Smithson (1987) has made the most important contribution to fuzzy logic practices in the social fields with the fuzzy sets theory by the end of the 1980s. Herrera et al (2001) sought a solution to the problem of personnel selection, using linguistic genetic algorithms. Subsequently, Fourali (1997), Chang and Yeh (2002) have also done significant studies.

5. Studies Conducted with Fuzzy Logic in the Field of Education

The request of the universities and the community is not only to educate students, but also to determine whether they are appropriate for specific education and tasks. The current standard systems are based on finding the answers as "yes" or "no" whether students are appropriate for the specific situations. In fact, lines are not so clear-cut as in real life. Educators know that these numerical values are not enough to characterize students' abilities and skills. To be able to categorize them with more advanced logic is more important. With Fuzzy Logic applications, students and educators can be presented a gudiance with a more valuable logic.

The question of "Why Fuzzy Logic?" can be answered as in the following way. Fuzzy Logic is easy to understand because it is close to way of thinking process of the human. Since it is far from comprehensive analysis, and it has a simple structure

because of its intuitive approach. Fuzzy Logic is flexible. Instead of changing a system by starting from the scratch, it can adapt to the system entering as a layer. Fuzzy Logic constantly improves itself through experimentation. It is derived from the natural language. Fuzzy Logic can comprise the problems and solutions which are defined by everyday language that is the only means of developed human interaction for centuries.

Studies conducted using fuzzy logic in the field of education are fewer than the ones in the engineering field. Cuevas, Cienfuegos, Rojas and Padilla (2015) about Intelligence Optimization Algorithm Based on the Behavior of the Social-Spider, Balkir, Alniacik and Apaydin (2011) Fuzzy logic in legal education, Some of the studies conducted with fuzzy logic for e-learning, Tokmak, Baturay and Fadde (2013); Kazancoglu and Aksoy (2011) A fuzzy logic-based quality function deployment for selection of e-learning provider. Dias, Diniz and Hadjileontiadis (2014); Bunyatova and Salamov (2014) studied distance education and fuzzy logic. Chang, Juan and Chou (2014) studied better discipline strategies for schools by fuzzy logics. Al-Aubidy (2005) applying fuzzy logic for learner modeling and decision support ın online learning systems, Van Hecke (2011) predicted characterize students with fuzzy expert system. Shekhar, Venkatasubbaiah and Kandukuria (2012) Establishing the overall service quality of engineering education: fuzzy logic approach.

The studies conducted with fuzzy logic in hypermedia practices in cooperative learning and education include; the studies of Hadjileontiadou and Hadjileontiadis (2003); and Kavcic (2001), Kavcic et al., (2003); Mullier (2000) Barros and Verdejo (1999), Hadjileontiadou, Nikolaidou, Hadjileontiadis, and Balafoutas (2003, 2004); Hwang, Huang and Tseng (2004) Gravani, Hadjileontiadou, Nikolaidou, and Hadjileontiadis (2007).

Some of the studies conducted with fuzzy logic for student-centered learning approach include the studies of Capaldo and Zollo (2001), Dweiri and Kablan (2006). Zafra and Ventura (2009) predicted whether a student can pass or fail. Lykourentzou et al. (2009) used multiple genetic algorithms on the basis of an evaluation of results derived from three different methods to predict whether a student would quit a course or school. Arı and Vatansever (2009) have conducted a study of fuzzy logic-based career guidance in order to determine students' professional skills and to provide education in appropriate fields. For the education practices based on multiple bits of intelligence or learning styles, Kazu, and Özdemir (2009);Gravani et al. (2007); Chua et al. (2013). Many studies conducted with fuzzy logic in many affective fields such as personal learning, social learning, adult learning, incidental learning, organizational learning, and situated learning Gökmen et al. (2010); Claxton (1996); Hoban (2002), and John and Gravani (2005).

6. Method

In the study, attitudes of prospective teachers towards graduate education, their genders, their knowledge level on graduate education, their university entrance scores,

their grade levels in undergraduate education. their order of preference, and their suitabilities to enter graduate education were analyzed with Fuzzy Logic

In our study in which relationships of all these components mentioned above with each other, survey (scanning) method, of quantitative research methods, was used and the relational scanning model was preferred.

6.1 Instruments used in the study

In order to determine the above mentioned personal information of students and their attitudes towards graduate education in the research, "*Attitude scale towards graduate education*" by Konokman and Alıcı (2014) and other quantitative data regarding students were used.

The attitude scale developed by Konokman and Alıcı (2014) consists of 4 components. These components are named as personal development, negative emotions, willingness and behavioral representation. Cronbach alpha reliability coefficient for the whole scale is .939; and reliability coefficients of the components are .909; .850; .835 and .821. The four components clarify 57.171% of total variance.

Since 5 likert-type scale was used in this study, it has the characteristics of a descriptive research with the aim of determining the students' attitudes for graduate education. Descriptive method which is usually a kind of survey method is a comprehensive method related to groups. It is done on many objects or subjects within a certain time. According to Yıldırım and Şimşek (2008), the descriptive model is done without changing the relationship between the variables by analyzing the current situation of the case. The data obtained by this research model is summarized and interpreted according to the predetermined themes.

For the evaluations of Fuzzy Logic, Matlab and Neural solution programs were used. In order to measure the students' level of knowledge about the graduate education, a form that had entry requirements for graduate education was prepared and the students were asked to mark the boxes indicating "I have heard it for the first time" or "I have been aware of it". With the answers of these forms, the option indicating "I have been aware of it" out of 10 questions was evaluated with 10 points and each student's score was obtained.

6.2 Sample of the Study

The students of Yıldız Technical University, Marmara University and Necmettin Erbakan University Faculty of Education Primary School Mathematics Teaching Department and Pedagogical Formation group have comprised the sample of our research. The study was conducted with a total of 390 prospective teachers.

In this study, purposive sampling method was used.

The study group of the research was determined using easily accessible sampling method. This sampling method accelerates speed and practicality to the research, because in this method, researcher choses the situation that is easy to access (Yıldırım and Şimşek, 2006).

According to Balci (2006), purposive sampling method is a type of method in which researcher uses his/her own judgement about who to choose and chooses the most appropriate sample. Purposive sampling was selected according to the maximum variation method. In maximum sampling method, the aim is not to generalize to the universe through obtaining diversity, but it is to find out what kind of partnerships and similarities between diverse situations (Şimşek ve Yıldırım, 2004).

With maximum variation sampling, it has been based on creating the sample from homothetic and different situations in itself. In the study, this method was used by selecting three different universities and pedagogical formation group.

Table 1: Departments creating the sample of the study and the numbers of students

University/ Grade level	**Faculty of Education Primary Education (1.year)**		**Faculty of Education Primary Education (4.year)**		**Pedagogical Formation Group**		**Total**
Gender	Female	Male	Female	Male	Female	Male	
Yıldız Technical University	37	8	34	6	-	-	85
Marmara University	39	11	40	12	-	-	102
Necmettin Erbakan University	56	18	30	7	-	-	111
Pedagogical Formation Group	-	-	-	-	60	32	92
Total	132	37	104	25	60	32	390

When the literature is reviewed, the studies indicated that the attitudes of graduate students in different years were varied towards graduate education. (Ünal and İlter, 2010; Konokman and Alıcı, 2014). For this reason, attitudes of prospective teachers studying in different years of Faculty and in Pedagogical Formation Group were found to be worth analyzing.

7. Results and Findings

Firstly, the data was collected and written in the log form. The software was prepared in MATLAB program and the suitability of each student for graduate education was evaluated. Fuzzy Logic consists of three stages: fuzzification, inference engine, and defuzzification. "*Fuzzification is the process where actual values as inputs in the system are blurred. Each input value is assigned a value of membership and turned into linguistic forms. The second stage is where rules are processed. Here, rules are derived in the form of "if- then". Inputs are handled in accordance with the rule table. The third stage, defuzzification, involves transforming fuzzy values into actual values.*" (Yıldız, Bal, and Gülseçen, 2013; p.148)

Block diagram of the operation which was designed to determine the susceptibility to graduate education as a fuzzy logic-based is shown in Figure 1.

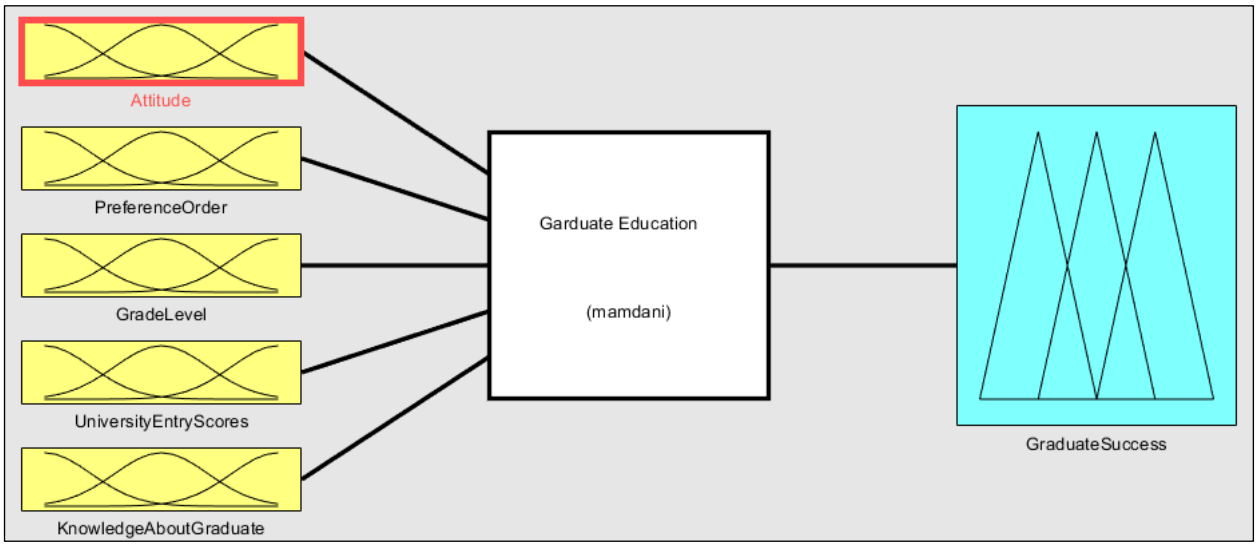
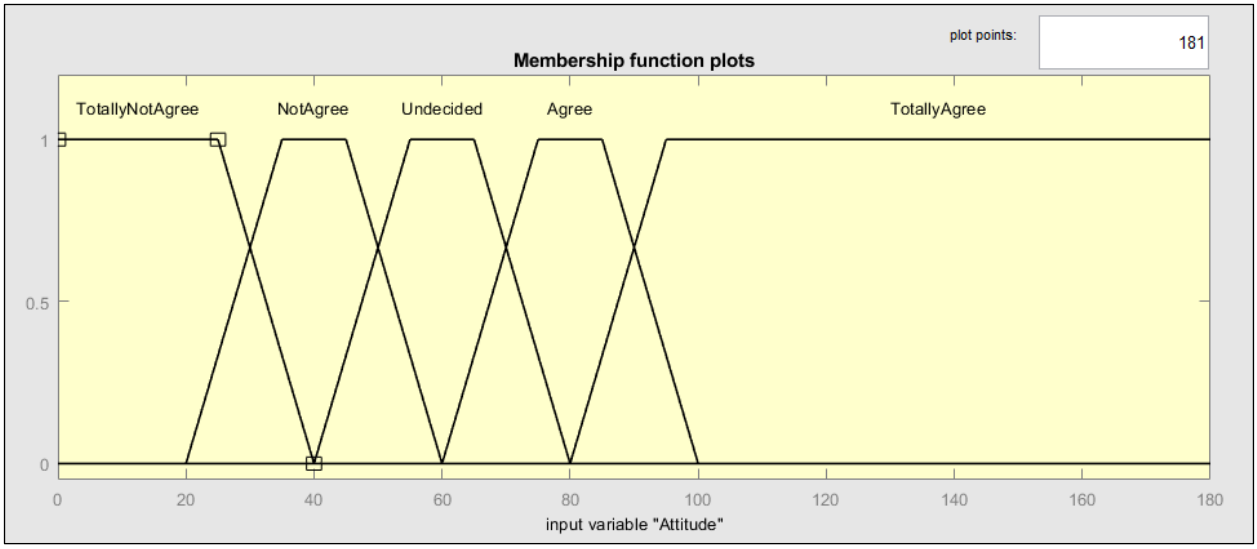


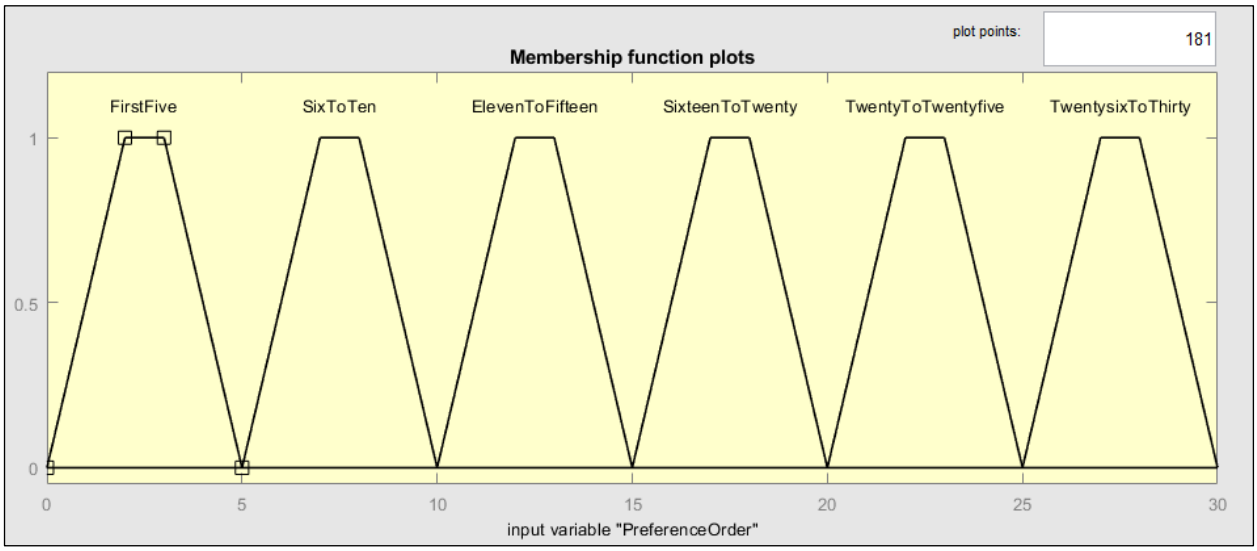
Figure 1: Block diagram of the system

5 parameters are given for the entry into the system:

- Attitude;
- Preference Order;
- Grade Level;
- University Entry Scores;
- Knowledge about Graduate.

In the conducted study, the membership function for that entry is set as in Figure 2.

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181
Membership function plots
FirstFive
SixToTen
ElevenToFifteen
SixteenToTwenty
TwentyToTwentyfive
TwentysixToThirty
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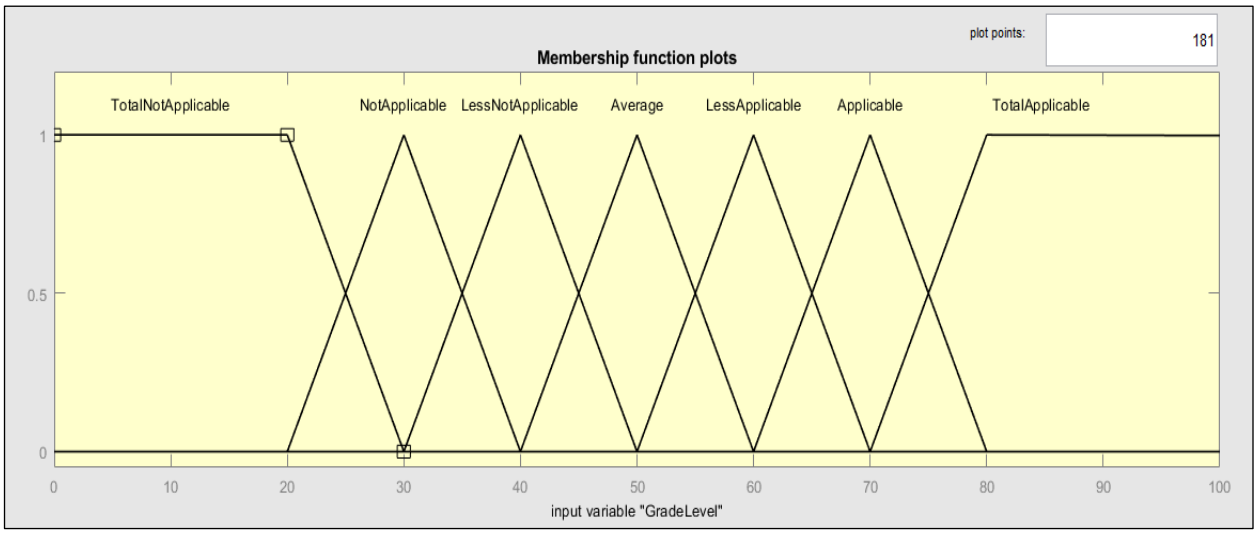
0.5
0
0
5
10
15
20
25
30
input variable "PreferenceOrder"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181
Membership function plots
TotalNotApplicable
NotApplicable
LessNotApplicable
Average
LessApplicable
Applicable
TotalApplicable
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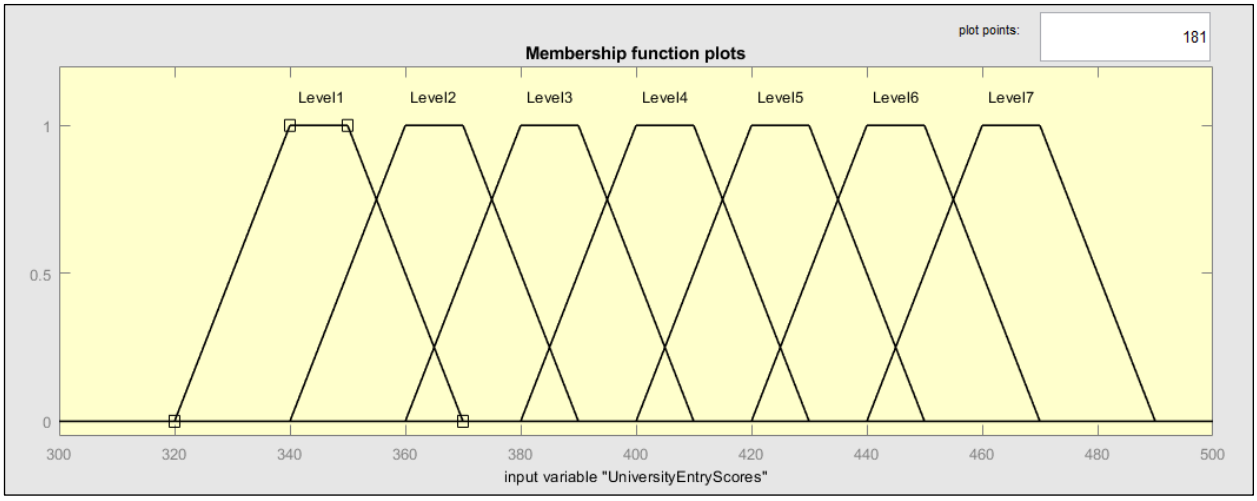
10
20
30
40
50
60
70
80
90
100
input variable "GradeLevel"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Membership function plots
Level1
Level2
Level3
Level4
Level5
Level6
Level7
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400
420
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460
480
500
input variable "UniversityEntryScores"

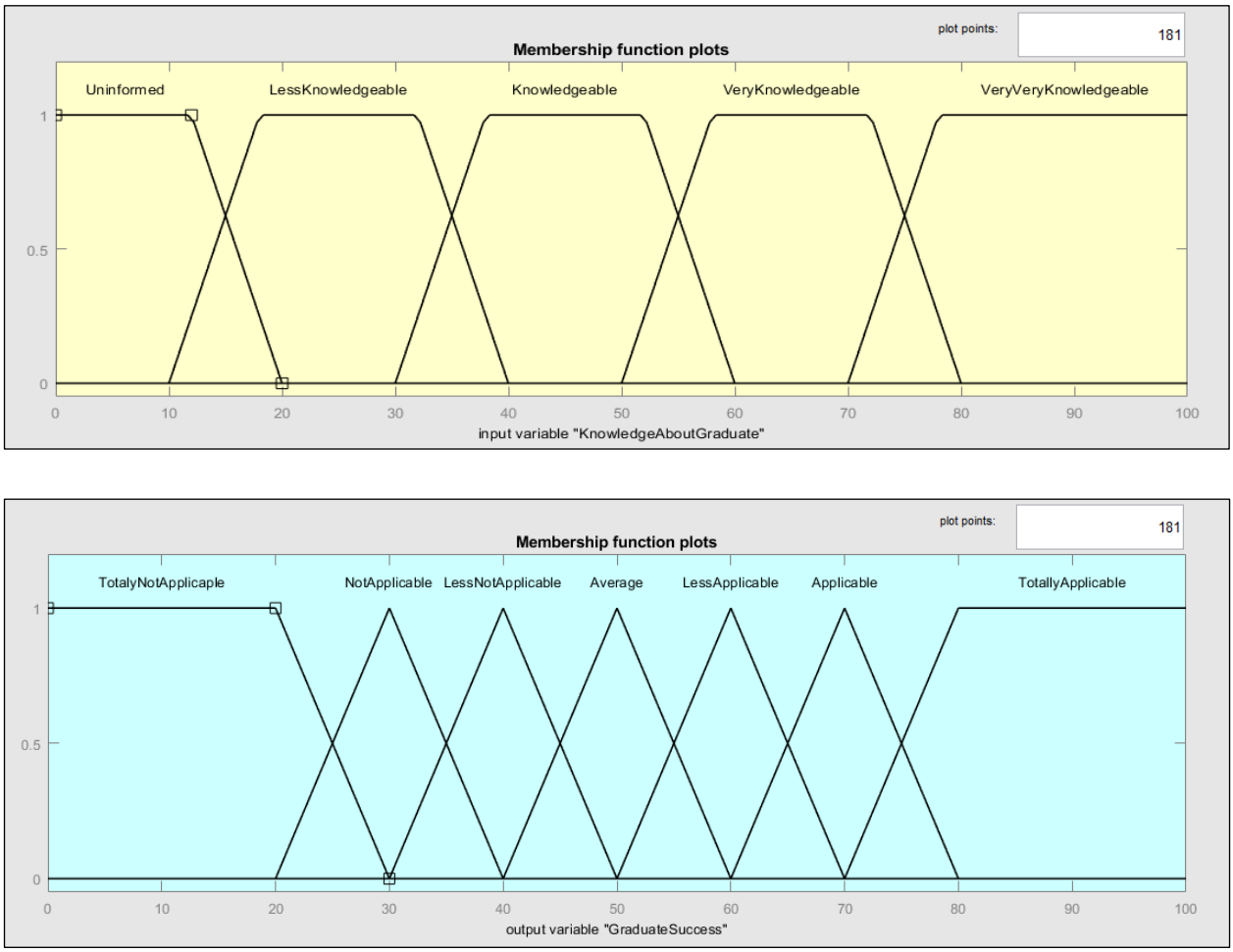

Figure 2: Fuzzy logic system membership function

A membership function is comprised of shapes determined by its linguistic terms. The most commonly used shapes are triangle, trapezoidal or parabolic. This study is based on the triangle membership functions. Each term has a specific range of values and the ranges are determined through a series of operations. Fuzzy rules can be created depending on data or by consulting experts. In this study, rules are generated by consulting experts. Some rules of the model are as follows.

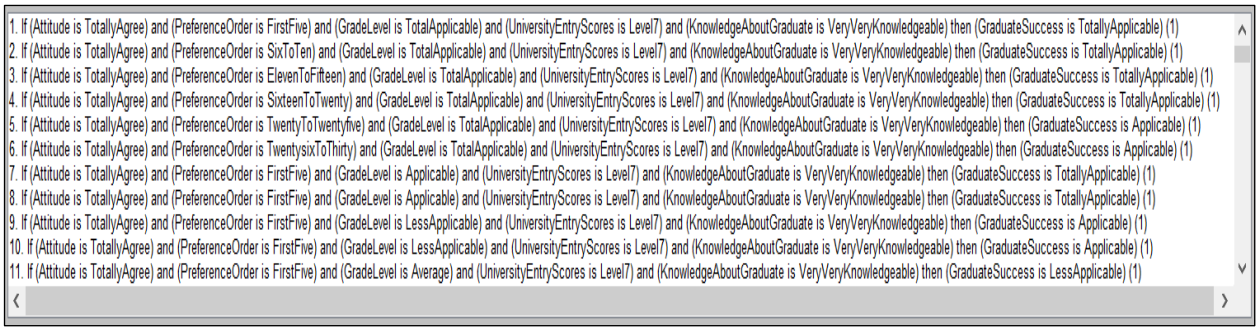

Figure 3: Fuzzy logic system rule bases

In the system when creating a rule base since there are 5 (five) inputs and 1 (one) output; 11 (eleven) of these created rules are seen above. In the resolution process of the

system, when AND operation is used, the MIN value of membership function is taken, and when OR operation is used, the MAX value of membership function is taken in obtaining implication deductive result. The MAX method is used in the aggregation process, and MIN method solution is preferred in the total set consisting of the membership functions.

Defuzzification unit transforms fuzzy control signal coming from the mining unit into a single numerical value. There are many methods in control strategies. This study preferred the Centroid Method which is the most widely used.

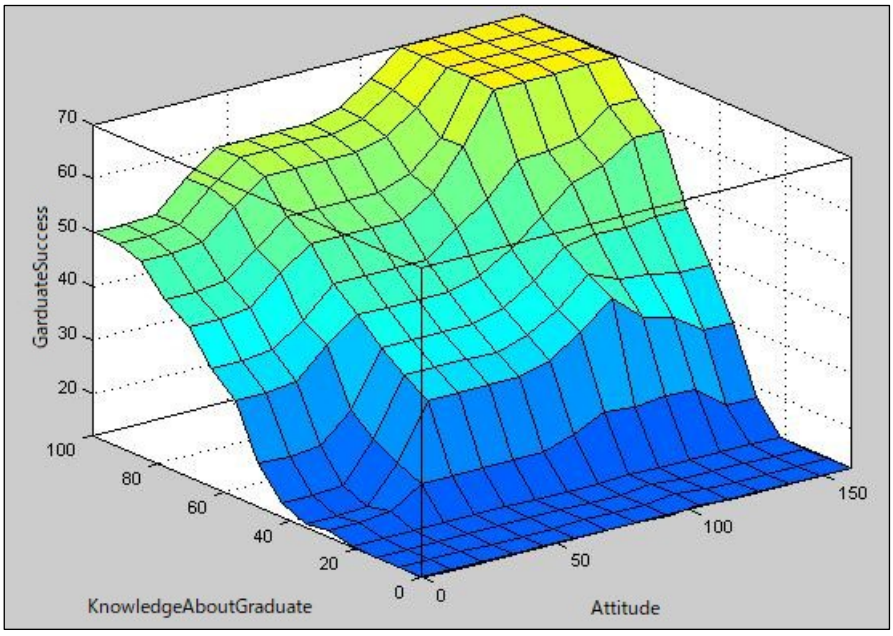

Figure 4: Graduate Success- Knowledge about Graduate-Attitude graphic

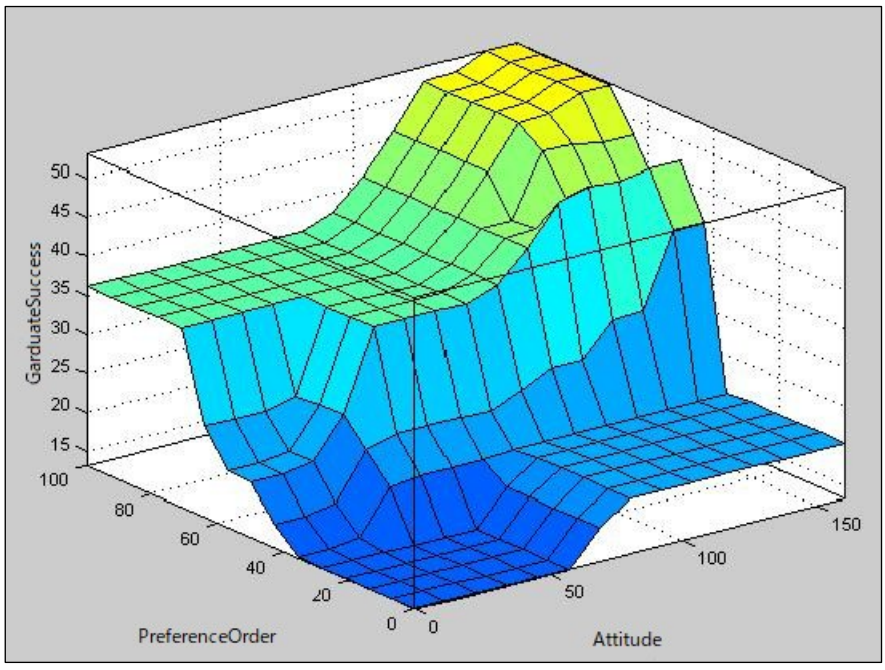

Figure 5: Graduate Success- Preference Order-Attitude graphic

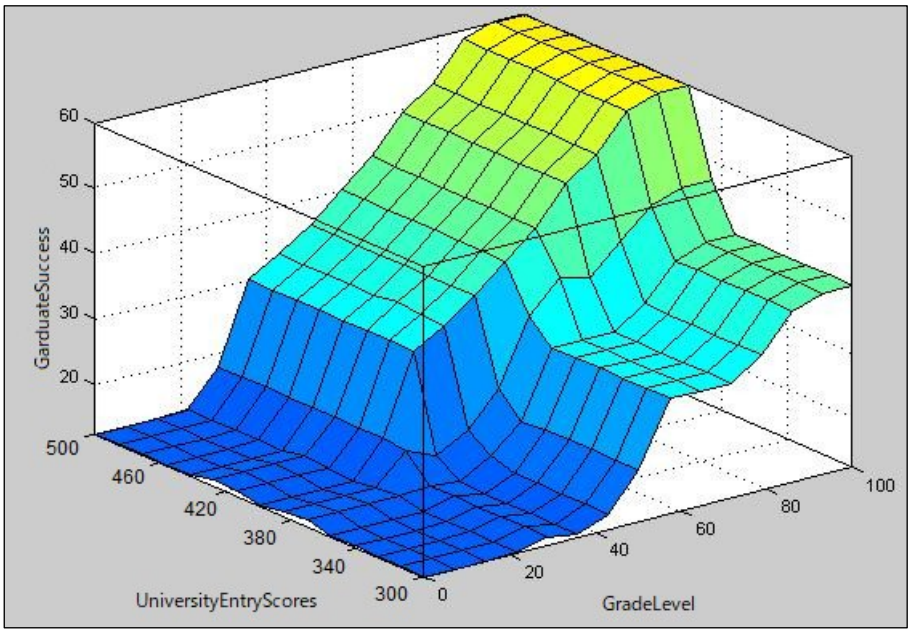

Figure 6: Graduate Success- University Entry Scores-Grade Level graphic

Table 3: Departments creating the sample of the findings and the numbers of students

University/ Grade level	**Faculty of Education Primary Education (1.year)**	**Faculty of Education Primary Education (4.year)**	**Pedagogical Formation Group**	**Total**
Yıldız Technical University	9	17	-	26
Marmara University	12	18	-	30
Necmettin Erbakan University	8	13	-	21
Pedagogical Formation Group	-	-	21	21
Total	29 (%7.4) 21 female, 8 male	48 (%12.3) 36 female, 12 male	21 (%5.3) 12 female, 10 male	98 (%25.1) 69 female, 30 male

In the research, a fuzzy logic rule base was created and 98 (25.1%) of the analyzed data were decided to be suitable for graduate education program. 29 (7.4%) of these prospective teachers were from the first year, 48 (12.3%) of them were from the fourth year, and 21 (5.3%) of them were from the formation group. The group with the highest percentage of prospective teachers considered to be suitable for graduate education is fourth year undergraduate students with 12.3%. The group with the lowest percentage is formation students with 5.3%.

7.1 Findings of the first year students

In the findings related to the first year students of three universities, 29 (7,4%) of the students were found to be suitable to be admitted to a graduate education program as a

result of the analyses conducted by fuzzy logic. 9 of these students were studying at Yıldız Technical University, 12 of them were at Marmara University, and 8 of them were at Necmettin Erbakan University. 21 of these students were females, while 8 of them were males. The order of preference of 10 students' departments was seen to be between the range of 6-10. It is noticeable that their university entrance exam scores were between the range of 386-411 points. Their being knowledgeable about graduate education seems to be at midlevel (41-60).

7.2 Findings of the fourth year students

In the findings related to the fourth year students of three universities, 48 (12,3%) of the students were found to be suitable to be admitted to a graduate education program as a result of the analyses conducted by fuzzy logic. 17 of these students were studying at Yıldız Technical University, 18 of them were at Marmara University, and 13 of them were at Necmettin Erbakan University. 36 of these students were females, while 12 of them were males. The order of preference of 24 students' departments was seen to be between the range of 6-10. It is noticeable that their university entrance exam scores were between the range of 438-463 and 464-489 points. Their being knowledgeable about graduate education seems to be at the highest level (81-100).

7.3 Findings of the formation students

In the findings related to the formation students, 21(5,38%) of the students were found to be suitable to be admitted to a graduate education program as a result of the analyses conducted by fuzzy logic. These students were studying their fourth years at Faculty of Science and Literature Mathematics Department of Yıldız Technical University by the time of the conducted study. These students were also enrolled at the formation program of the same university. 12 of these students were females, while 10 of them were males. The order of preference of 14 students' undergraduate departments was seen to be between the range of 11-15 and 16-20. It is noticeable that their university entrance exam scores were between the range of 354-359 points. Their being knowledgeable about graduate education seems to be at the highest level (81-100).

Based on the number of students, the success rates of the groups varied, because the number of students in the group was different. The success rates of the groups were in the following: 1st year students were 17,15% (admitted in the 2015-2016 academic year), 4th year students were 37,20% (admitted in the 2012-2013 academic year), the formation group students were 22,82% (admitted in the 2012-2013 academic year). In this case, the most successful group was 4th year students' group, while 1st year students' group and the formation group vary since the number of students was different.

8. Discussion

In this study, in the light of information related to prospective mathematics teachers, their admission status to graduate education was classified by fuzzy logic. In the study,

the components other than the requirements of getting admitted to graduate education in Turkey, which are ALES (Academic personnel and graduate education entrance exam), College GPA (graduation grade point average) and a foreign language score have been considered. These components are attitude, gender, grade level, order of preference, university entrance score, and level of knowledge about graduate education. With the classification done when these components are taken into consideration, students' suitabilities to graduate education can be assessed.

In the researches based on many criteria for the factors affecting student achievement, the importance of this case was reported. In their study, Keser and Sarıbay (2007) aimed to determine the factors affecting student achievement at private and state universities and to reveal the dimensions that can not be observed by factor analysis by considering the several criteria affecting student achievement. Demirtaş (2010) analyzed the relationship between school culture and student achievement. Jones-White et al. (2010), in their study, redefined student achievement and measured it in higher education institutions using multiple regression techniques. Prevatt et al. (2011), in their study in which they created an academic achievement inventory for college students, studied on the development and application of the scale for college students. Memduhoğlu and Tanhan (2009) developed a scale in order to explain the organizational factors that affect the academic success of college students and reached the conclusion that the scale is a reliable instrument.

The evaluation of the factors that affect student's academic success by fuzzy logic has provided more consistent information comparing with classical logic. There are also other studies supporting fuzzy logic advantageous usage for complex parameters. Valluru mentioned the advantages of fuzzy logic in his study in 1995 as: *"These are the facts that models can be established in an easy way through linguistic variables, imprecise/contradictory inputs are allowed, rules can be established in an easy way to design the model, and linguistic terms between input variables and output variables can be understood easily"* (Yıldız, Bal and Gülseçen, 2013; p.148). Similarly, Taylan and Karagözoğlu (2009) stated that opinions created with the rule-based system and the relationship between the membership functions could be understood better.

When the results of the research are considered, it has been reached the findings that indicate the female students' admission to graduate education is higher when compared to the male students. These findings show parallelism with Ünal and and İlter's findings (2010) that indicated that there was a significant difference on the attitudes of female prospective classroom teachers toward graduate education. It emphasizes that females look more positively to graduate education than males and they have higher career perceptions. In terms of gender variable, the reasons of the significant difference on the attitude points of females towards graduate education can be considered them to see postgraduate education as a prerequisite for being an academic staff and to find profession of academician prestigious. Besides, Konokman and Alıcı (2014) mentioned that gender variable did not have an influence on the attitudes towards graduate education in their studies.

In the findings related to grade level, admission of fourth year students to graduate education seems to be higher than the other year students. In this case, the increase in willingness to get graduate education can be related to the increase in the level of being informed as the level of grades increases, understanding of the importance of graduate education while planning for the future or the fear of not being appointed as teachers, which might lead them to get graduate education. Similarly Ören et al (2012) reported that the level of willingness of fourth year prospective teachers were higher compared to third year students. Formation students are seen to be at the lower rank and be reluctant to get graduate education comparison to other research groups in the study on graduate education. This situation can be explained by the facts that most of teachers who were studying formation did not have much time since they were also working at the same time and their first priorities were to be appointed by the government. Considering these formation students were the graduates of Faculty of Science and Literature Mathematics department, the following reasons could have caused low motivation and low attitudes on them: their graduate fields that they could apply were limited and in undergraduate period, they were admitted to Faculty of Science and Literature Mathematics department with lower scores compared to their peers coming from Faculty of Education. It is seen that there was no obvious difference between the obtained results of three different faculties where undergraduate students were studying by the time of research. This case can be explained as the entrance scores for the universities where the study conducted were close to each other and their student admission was almost at the same percentile.

In the level of knowledge of prospective teachers towards graduate education, formation students are seen to have more information and 4th year students are seen to be more knowledgeable than 1st year students. It can be said that understanding the importance of graduate education and being encouraged to have graduate education while getting undergraduate education can lead to have graduate education. A similar finding has been reached by Karakütük (2000). Karakütük (2000) states that some of the reasons teachers' not preferring to get graduate education is teachers' failure to understand enough the importance of graduate education and their not being knowledgeable about the institutions and programs they can get.

Even though it is not included in this research, it is known by prospective teachers that ALES score has a great importance for the admission to the graduate school. In ALES exam that is based on the mathematical reasoning and understanding and interpreting what is read, mathematics students' being successful in this exam and getting high scores generally is not a concern for the study group and so it is thought that this situation reflected on attitude points. This case is discussed in the studies about the students who were studying other teaching departments. (Ören et al, 2012; Erkılıç, 2007)

8.1 Suggestions

In order to ensure prospective teachers to have a higher attitude towards the graduate education, their gaining awareness of research and being informed about graduate

education from the first years of college can provide significant benefits. Karakütük (2000) stated that teachers' not being encouraged about graduate education during their undergraduate studies caused them to have negative attitudes towards graduate education. In addition, inadequate quota at graduate schools and a foreign language score requirement as a prerequisite for graduate education are considered as barriers for prospective teachers to do master degree (Karakütük, 2000). Prospective teachers in different departments may be included in the study. Considering different components related to the prospective teachers and conducting researches using other methods of artificial intelligence such as fuzzy logic, students and educators can be provided an effective prediction and classification opportunities.

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