Evaluating the Attitudes of Prospective Elementary School Mathematics Teachers Towards Postgraduate Education in Turkey and Other Components with Fuzzy Logic*

Türkiye'de İlköğretim Matematik Öğretmeni Adaylarının Lisansüstü Eğitime Yönelik Tutumları ve Diğer Bileşenlerin Bulanık Mantık ile Değerlendirilmesi*

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ABSTRACT

Postgraduate education, which is regarded as necessary in the field of education in order to improve the qualifications of teachers seen as culture workers, has become more important than it used to be. In this context, the attitudes of prospective teachers toward pursuing a postgraduate education are crucial. In this study, all of the components, including grades, scores and the attitudes of prospective teachers were interpreted by a fuzzy logic-based evaluation for admission to postgraduate education. The attitudes of the underpostgraduate students towards postgraduate education were determined according to 'the Postgraduate Attitude Scale'. The students' four year college grade point averages and 'academic personnel and postgraduate education entrance exam' scores were also taken into account, and their eligibility for postgraduate education was assessed by using fuzzy logic rules. The study was conducted with 155 prospective teachers who were underpostgraduate students in the program of mathematics teaching for elementary school. During the study, after the test operation was done with one-third of the data, an 80.77% result of the general prediction rate was obtained. These results were further analyzed in detail, and 76 out of 96 students who were eligible for postgraduate education and 48 out of the 59 remaining students were predicted correctly. The data obtained from the study was assessed using fuzzy logic methods, and this approach has proven to reach more effective and accurate results.

Keywords: Fuzzy logic, Postgraduate education, Attitude

ÖZ

Bir kültür çalışanı olarak değerlendirilen öğretmenlerin niteliklerini arttırmak için günümüzde diğer alanlarda olduğu gibi eğitim alanında da gereklilik gibi görülen lisansüstü eğitim, geçmiş dönemlere nazaran daha önemli hale gelmiştir. Öğretmen adayların lisansüstü eğitime dair tutumları bu bağlamda oldukça önemlidir. Lisansüstü eğitime girişte lisans mezuniyet ortalamaları ve 'akademik personel ve lisansüstü eğitimi giriş sınavı' puanları ağırlıklı olarak dikkate alınmaktadır. Araştırmamızda bu verilerin yanında öğretmen adaylarının tutumlarını da dikkate alarak, lisansüstü eğitime girişte bütün bu bileşenlerin bulanık mantık tabanlı bir değerlendirme ile yorumlanmasına yer verilmektedir. Bu çalışmada, öğrencilerin lisansüstü eğitime yönelik tutumlarının belirlenmesinde 'Lisansüstü Tutum Ölçeği' ile elde edilmiş sonuçlar yanı sıra öğretmen adaylarının lisans mezuniyet ortalamaları ve 'Akademik Personel ve Lisansüstü Eğitimi Giriş Sınavı' puanları da dikkate alınarak lisansüstü eğitime uygun öğrencilerin değerlendirmesi, bulanık mantık kurallarıyla gerçekleştirilmiştir. Çalışma 155 ilköğretim matematik öğretmenliği öğrencisi ile yürütülmüştür. %80.77'lik genel öngörü oranı ile sınıflama yapılmıştır. Öğretmen adaylarının tutum puanları ve eldeki diğer verilerin değerlendirmesi bulanık mantık yöntemi ile yapılmış ve bu yaklaşımla daha etkin ve doğru sonuçlara ulaşılabileceği gösterilmiştir.

Anahtar Sözcükler: Bulanık mantık, Lisansüstü eğitim, Tutum

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INTRODUCTION

Postgraduate education is important for individuals who are pursuing or will be pursuing the profession of teaching—a profession essential to the production, sharing, and transferring of information. When the body of literature was examined, various definitions of postgraduate education were encountered. Karakütük (1999) stated that postgraduate education consists of masters and doctoral education, specialization training in medicine and study of proficiency in branches of arts along with training, scientific research, and necessary practices. Varış (1973: 136) defined postgraduate education as "an activity that leads to postgraduate degrees at the university level, and aims to train scientists and instructors who are going to contribute to knowledge through research that meets the needs of the evolving community." Arıcı (2001) indicates that postgraduate education creates solutions when it comes to the production and dissemination of science and art, and the formation of an accurate perception of social issues. Since postgraduate education is considered to serve multiple purposes, the perception that postgraduate education is only conducted to meet the needs of lecturers at universities is one of the misconceptions held by people (Ören et al., 2012).

The significance of postgraduate education is mentioned in many studies carried out in Turkish as well (Çoklar & Kılıçer 2007; Karakütük 1999; Aslan 2010 and Çepni & Küçük 2007). Similar studies concerning the importance of teachers' training and the enhancement of teachers' qualities are observed in international studies (Berry et al., 2010; Farooq & Shahzadi, 2006; McGarrell, 2010; Moussu & Llurda, 2008; Al-Hazmi, 2003). There are also some studies available in which researchers suggest postgraduate education opportunities should become more common for teachers to improve themselves academically (Uras & Kunt, 2005; Şenel et al., 2007; Çepni & Küçük, 2002). Tunç and Güven (2007) emphasized that the era during which an under postgraduate education provided individuals with privilege and distinction has come to an end; today what makes individuals privileged and distinguished is masters and doctoral degrees. According to Uras and Kunt (2005), postgraduate education opportunities should become more available for teachers to improve their skills and capabilities. In addition, in order for teachers to follow educational research studies and conduct similar studies themselves, they should be encouraged to pursue masters or doctoral degrees (Çepni & Küçük, 2002). Ören et al. (2012) also emphasized that a postgraduate education shapes the personal and professional development of teachers, who play an important role in shaping the individuals of the future. Postgraduate education becomes crucial in the personal and professional development of teachers because the in-service training provided by the Turkish Ministry of Education is not at the level to fulfill all of the needs and requirements (Yaşar, 2000; Şen, 2003).

Teacher Education and Recruitment in Turkey

There are many reasons that encourage teachers to pursue postgraduate education. According to Kara (2008), some of the reasons for why many teachers started pursuing postgraduate education include following scientific and technological developments, acquiring an awareness of educational research studies, and developing their careers further or specializing in the profession. Alabaş et al. (2012) stated that personal development and obtaining professional career are the primary reasons why teachers pursue postgraduate education. Aslan (2010) noted these reasons to be pursuing individual and social improvement, acquiring a scientific perspective, advancing in their career, following innovations and developments in the academic discipline and enhancing the quality of teaching practices in the classroom as a teacher.

Teaching programs are one of the fields that are highly preferred when it comes to students' higher education choices. However, while the rate of preference for teaching programs rises, the number of teachers who have already graduated from these programs and could not be appointed as teachers in institutions also increases. Despite the high demand for the teaching programs, the problems experienced by the students in the process of appointment and especially limited appointments in some fields are other factors leading students to pursue post education. On the other hand, the rate of students whose ideals are to have an academic career is substantial. In order to have a successful academic career, students' must have a consistent motivation and studying discipline starting from their underpostgraduate years. In this process, affective factors accompanying the student are quite important. The effects of attitude on the success are as substantial as the other affective features. There are also different definitions for attitude (Di Martino & Sabena, 2011; Güney & Bozkurt, 2012). Hannula (2007), Daskalogianni & Simpson (2000), and Ruffell et al. (1998) have described attitude as a complex structure. Basically, Kolasa (1979) has defined attitude as "a predisposition to react positively or negatively, to a person, place or circumstances". It is emphasized that attitude is not a directly observable feature, but rather it is a tendency attributed to the individual by making inferences from his/her behavior (Anastasi & Urbina, 1997).

Many studies analyzing the attitudes of prospective teachers regarding postgraduate education in terms of different components exist (Senemoğlu & Özçelik, 1989; Johnson & Howell, 2005; Kara, 2008; and Alabaş, 2011). As seen from these studies, the impact of attitude on success is not only highlighted once again, but it is also believed to be effective in shaping academic career plans of prospective teachers. In scientific studies, the revealing of objective reality is accomplished using a variety of tools. Generally, as the relationship between the event being examined and observation and universal integrity becomes more complex, receding from accuracy and some uncertainties emerge (Klir, 2006). Fuzzy logic is an effective tool that can be used to express such a situation. Fuzzy logic, in the simplest words, is a reasoning logic. While traditional logic deals with the ideal results obtained from idealized concepts and propositions, fuzzy logic generates proximate solutions by discussing confusion and uncertainty in the real world (Klir & Yuan, 1995). When there is not enough information about the analyzed event or an expert's opinion is needed for the solu-

tion of the problem, fuzzy approaches are widely used. The scales used for determining affective features such as attitude are evaluated by educators. However, rapidly developing artificial intelligence technologies can be used not only in many fields and for various purposes but also in the evaluation of these scales, since these technologies affect educational institutions. Apart from the classical evaluation of the scales used in assessing attitudes, the field whose assessment through fuzzy logic has not been sufficiently conducted can be seen through literature review. However, fuzzy logic gives birth to the "many-valued logic," which shows that there are almost an infinite number of values between 0 and 1 as opposed to the classical logic, which simplifies everything in life as right or wrong just like 0 and 1.

Fuzzy Logic Method

Why Fuzzy Logic in Education? "One of the problems faced by teachers is the assessment of their students' knowledge and aptitudes. In fact, our society demands not only to educate, but also to classify the students according to their qualifications as being suitable or unsuitable for carrying out certain tasks or holding certain posts. According to the standard methods of assessment, a mark, expressed either with a numerical value within a given scale (e.g., from 0 to 10) or with a letter (e.g., from A to F) corresponding to the percentage of a student's success, is assigned in order to characterize his/her performance. However, this crisp characterization, based on principles of the bivalent logic ('yes or no'), although it is the one usually applied in practice, it is not probably the most suitable to determine a student's performance. In fact, the teacher can be never absolutely sure about a particular numerical grade characterizing the student's abilities and skills. In contrast, fuzzy logic, due to its nature of including multiple values, offers a wider and richer field of resources for this purpose. Therefore, the application of fuzzy logic that we shall attempt in this section seems to be a valuable tool for developing a framework for the students' assessment." (Voskoglou, 2013: 210)

Most of the studies with fuzzy logic are seen in the engineering field. Altaş and Sharaf (1992), Liu (1997), Li et al. (2000) about electric power, Kosko (1992) about machine and dynamical systems, Akiyama and Tsuboi (1996); Lo and Lam (1997); Henn (2000) have made studies on the field of transportation and traffic engineering. 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. In this study, the project manager selection process of a company operating in the IT sector and the criteria determined by the experts were evaluated by fuzzy numbers. Then, priorities were determined based on Lee and Li's fuzzy averages method and a computer program which operates these processes was developed. 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. Herrera et al. (2001) sought a solution to the problem of personnel selection, using linguistic genetic algorithms. 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. Subsequently, Fourali (1997), Chang and Yeh (2002) and Hu (2009) have also done significant studies.

Studies conducted using fuzzy logic in the field of education are fewer than the ones in the engineering field. Some examples of the studies conducted with fuzzy logic in hypermedia practices in cooperative learning and education include; the studies of Hadjileontiadou and Hadjileontiadis (2003), Mullier (1999) and Kavcic (2001), Kavcic et al. (2003); Barros and Verdejo (1999), Hadjileontiadou, et al. (2004); Gravani et al. (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. They recommended that further studies could focus on predicting student's grades and attempt to find the minimum length of time sufficient for prediction before the final exam. 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) conducted a study describing the determination of students' individual features with artificial intelligence with a fuzzy logic method. Gravani et al. (2007) in their study called "Professional learning: the fuzzy logic-based modeling approach" applied analysis of the relationships between the sectional quantitative, fuzzy logic-based model and a series of representative data of such variables (drawn from an in-service training program in Greece that were confronted with it. Chua et al. (2013), in their study named "On the possibility of a fuzzy method and its mathematical framework of OBE Measurements" described the approach of using fuzzy logic to design a measurement system in outcome based education.

In addition to these studies, there are also other studies conducted with fuzzy logic in many affective fields such as personal learning, social learning, adult learning, incidental learning, organizational learning, and situated learning. According to Gökmen et al. (2010), Hoban (2002), and John and Gravani (2005), this increases the need for the development of frameworks for looking at the PL, which links different learning perspectives.

Purpose and Research Questions

Subjective measures for instance; leadership, representation, and problem-solving skills are less measurable. In some cases, like in the measurement of attitudes, the assessment criterion is subjective or less quantitative. Depending on the evaluation system, fuzzy logic is suitable. Generally, researchers and consultants have a rather qualitative or vague approach on attitude problems concerning the postgraduate attitude. In the evaluation of attitude, fuzzy logic approach allows using professional approach in evaluating students. For admissions

into postgraduate education, GPA and ALES scores are mainly considered in Turkey. In this study, the attitudes of prospective teachers were taken into account besides these data. All these components have been interpreted by a fuzzy logic-based assessment for admission to postgraduate education. The attitudes of the underpostgraduate students towards postgraduate education were determined according to "the postgraduate attitude scale", which Ünal and İlter prepared in 5 Likert Type scale (2010). The students' four year college GPAs and ALES scores were also taken into account and their eligibility to postgraduate education were assessed by using fuzzy logic rules.

This study is thought to have unique, actual, essential, and functional qualities. It is unique, because studies that evaluate the attitudes of prospective teachers aiming at post postgraduate education with various components along with fuzzy logic have not been found in the literature. This study will contribute to the field that evaluates the attitudes of the prospective teachers regarding postgraduate education, which is a rising trend today in many sectors. It is essential because the evaluation using fuzzy logic aims to provide a serious alternative method to the classical evaluation methods in the field of education. Fuzzy logic is functional, because, as the study demonstrates, the susceptibility of prospective teachers towards postgraduate education is effectively assessed according to the fuzzy logic rules, students' "postgraduate attitude scale", GPA and ALES scores. In our study, the answer to the question: "based upon the GPAs, ALES scores and attitudes of prospective teachers towards postgraduate education, if fuzzy logic evaluation for their susceptibility to postgraduate education is an effective and alternative assessment tool" was searched.

METHOD

"In classical sets, an element is a member of a set or not. In mathematical terms, when an element belongs to a set, its degree of membership in that set is "1". However, when it is not a member of a set, its degree of membership in that set is "0". In fuzzy logic, nevertheless, each member has a value of membership that ranges between 0 and 1. Moreover, one element can be a member of more than one set. Take the statement that "those who are above 1.85 m. in length are tall". According to classical logic, those who are above 1.85 m in length are tall, but those who are 1.85 m in length are not tall. In contrast, fuzzy logic asserts that a person who is 1.85 m in length is tall with a 0.9 degree of membership and of medium height with a 0.1 degree of membership. Not everything in our lives is comprised of 1s and 0s as in classical sets. Rather, they have a number of uncertainties. In today's world, fuzzy logic is commonly used for modeling and solving a problem dominated by uncertainties" (Yıldız et al., 2013: 148).

Methodology

The data used in the study were obtained from 155 university students who were studying at Primary School Mathematics Teaching Department at Marmara University and at Yıldız Technical University during the 2014-2015 academic year. 26 of these students were doing their master degrees at Marmara

University Primary School Mathematics Teaching Department. Whether the rule-based system worked with these students' GPAs and ALES scores correctly or not was tested. 129 students were senior year students at the time of the survey. 61 of them were the students of Yıldız Technical University, and 69 of them were the students of Marmara University. In this study, the results obtained from "the postgraduate attitude scale" which Ünal and İlter prepared in five Likert Type scale (2010) were considered to determine the attitudes of the underpostgraduate students in regards to postgraduate education. The validity and the reliability of the scale didn't need to be determined for this study because it was determined by the researchers who developed the scale (the Cronbach alpha is 0.95). Along with these data, the GPAs and ALES scores of prospective teachers were taken into account.

Firstly, the data was collected and written in the log form. The data written in the log form was compared with approximately 55.000 lines. The software was prepared in MATLAB program and the suitability of each student for postgraduate 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 et al., 2013: 148)

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

Three parameters are given for the entry into the system:

The scores obtained from the scales were used to determine the attitude towards postgraduate education

- ALES scores
- GPA scores

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

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.

- If (attitude is totally not agree) and (ALES is very low) and (GPA is fail) then (postgraduate success is totally not applicable)
- If (attitude is totally not agree) and (ALES is very low) and (GPA is pass) then (postgraduate success is totally not applicable)
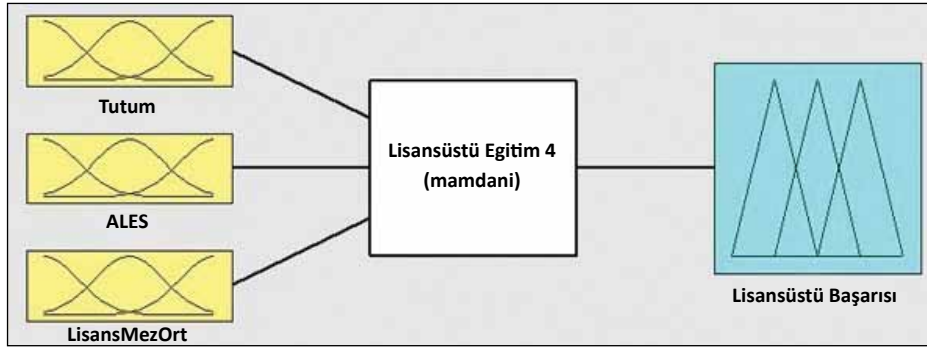
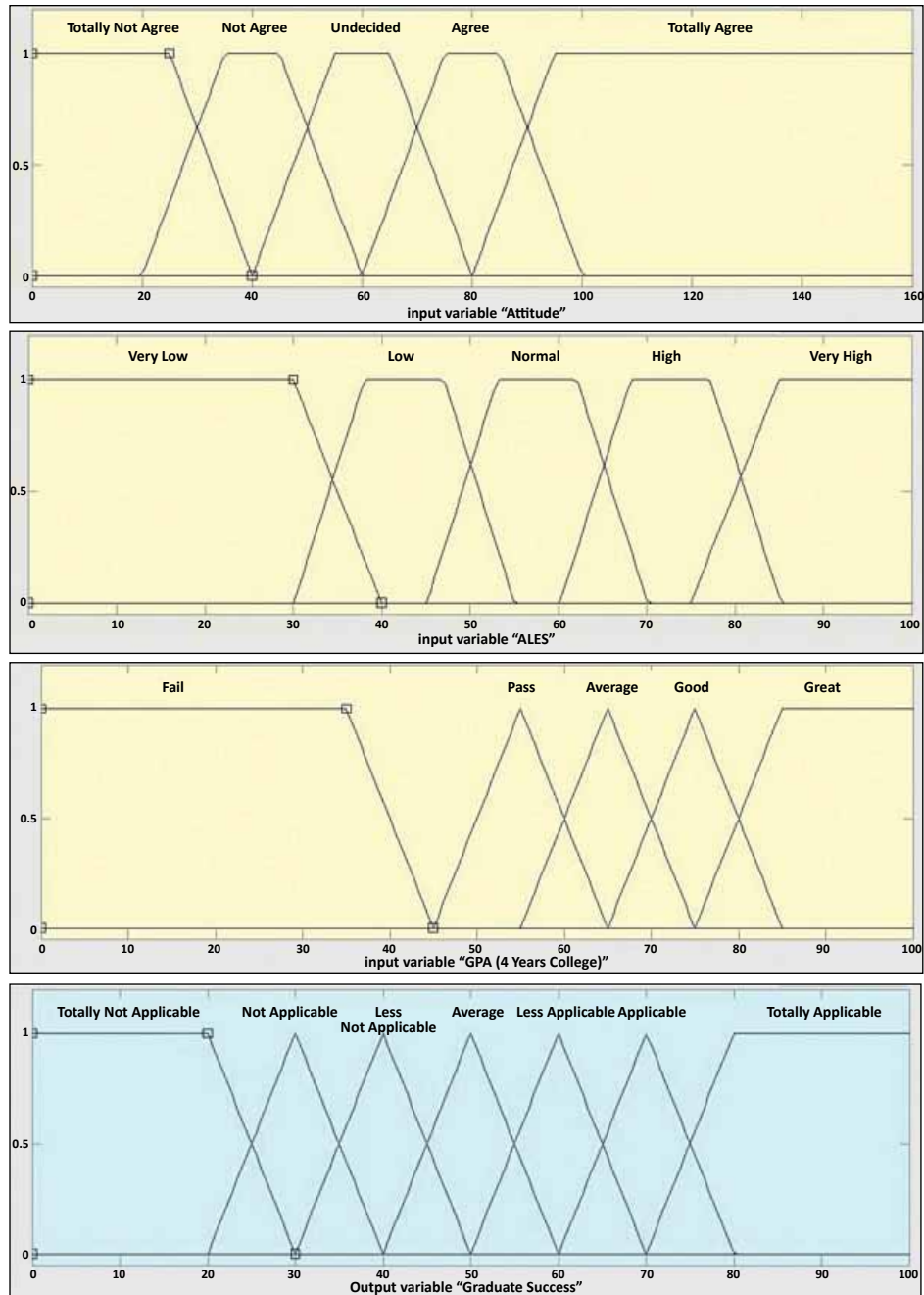**Figure 1:** Block diagram of the system.

Figure 2: Fuzzy logic system membership function.

- If (attitude is totally not agree) and (ALES is very low) and (GPA is average) then (postgraduate success is totally not applicable)

- If (attitude is totally not agree) and (ALES is very low) and (GPA is good) then (postgraduate success is not applicable)

- If (attitude is totally not agree) and (ALES is very low) and (GPA is great) then (postgraduate success is not applicable)

- If (attitude is totally not agree) and (ALES is low) and (GPA is fail) then (postgraduate success is totally not applicable)

- If (attitude is totally not agree) and (ALES is low) and (GPA is pass) then (postgraduate success is totally not applicable)

- If (attitude is totally not agree) and (ALES is low) and (GPA is average) then (postgraduate success is totally not applicable)

- If (attitude is totally not agree) and (ALES is low) and (GPA is good) then (postgraduate success is not applicable)

- If (attitude is totally not agree) and (ALES is low) and (GPA is great) then (postgraduate success is not applicable)

- If (attitude is totally not agree) and (ALES is normal) and (GPA is fail) then (postgraduate success is totally not applicable)

- If (attitude is totally not agree) and (ALES is normal) and (GPA is pass) then (postgraduate success is totally not applicable)

- If (attitude is totally not agree) and (ALES is normal) and (GPA is average) then (postgraduate success is not applicable)

- If (attitude is totally not agree) and (ALES is normal) and (GPA is good) then (postgraduate success is less not applicable)

- If (attitude is totally not agree) and (ALES is normal) and (GPA is great) then (postgraduate success is average)

- If (attitude is totally not agree) and (ALES is high) and (GPA is fail) then (postgraduate success is totally not applicable)

- If (attitude is totally not agree) and (ALES is high) and (GPA is pass) then (postgraduate success is totally not applicable)

- If (attitude is totally not agree) and (ALES is high) and (GPA is average) then (postgraduate success is not applicable)

- If (attitude is totally not agree) and (ALES is high) and (GPA is good) then (postgraduate success is less not applicable)

In the system when creating a rule base, 125 fuzzy logic rules were set, since there are 3 (three) inputs and 1 (one) output; 19 (nineteen) 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.

CONCLUSION

Due to the rapid improvements, the soft computing and artificial intelligence techniques have been widely used in different areas in recent years. In particular, the most effective soft computing technique, fuzzy logic has been applied to various disciplines and the results have proven successful predictions. Fuzzy techniques that successfully satisfied decision-making under conditions of uncertainty and system modeling are expected to enhance their effectiveness in Educational Sciences. Fuzzy forms of social events, education process measurements which include a particular degree of uncertainty, importance of the expert opinions and developments in educational technology provide a basis for increasing the practices.

For the admission of postgraduate education which is the focal point of the study, many cognitive and affective cases play roles together. Determining the susceptibility of the students for postgraduate education is important for both students and academics. Due to the non-linear structure of the problem, it is difficult to get a solution. Offering solutions to complex systems which contain numerical values, fuzzy logic is a well-known method for such problems. In this method, it is very important to design its parameters correctly. Even though this process would have been done by the researcher who knows the problem well, it is difficult to determine parameter values by human knowledge, since the relationships among parameters of the data set are complex. Thus, to create membership functions and "if - then" structured rules in accordance with the data set, the fuzzy logic method is preferred.

There are also other studies supporting the usage of fuzzy logic for complex parameters. Valluru mentioned the advantages of fuzzy logic in his study in 1995: *"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 et al., 2013: 148). Similarly, Taylan and Karagozoglu (2009) stated that opinions created with the rule-based system and the relationship between the membership functions could be understood better.

In the study, after the test operation was done with one-third of the data, the result which has 80.77% of the general prediction rate was obtained. When these results were analyzed in detail, in the 80.77%-rate result, 76 out of 96 students who are eligible for postgraduate education and 48 out of the 59 remaining students were predicted correctly. This conclusion was parallel to those of other similar studies. In their study in the United States in 2005, Allen & Seaman made successful predictions at the rate of 63% regarding the study on the students of 2500 universities who take online courses in distance education program. In 2013, Yıldız, Bal, and Gülseçen made predictions about the academic achievement of computer

Table 1: Postgraduate Success Are Calculated with Fuzzy Logic

Student	Attitude	ALES Score	GPA (4 year college)	Postgraduate School Success	Current Postgraduate Student
Student 1	71	65.475	96.03	76.7	1
Student 2	67	69.351	72.64	55.3	1
Student 3	64	70.606	84.57	70.01	1
Student 4	63	68.730	76.79	63.8	1
Student 5	61	66.981	78.46	58.01	1
Student 6	62	89.130	78.18	61.4	1
Student 7	68	82.744	74.48	57.9	1
Student 8	68	67.512	78.15	67.4	1
Student 9	64	64.274	80.85	67	1
Student 10	67	70.444	76.66	61.9	1
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.	.	.	.	.	.
.	.	.	.	.	.
Student 146	61	86.723	79.74	59.3	0
Student 147	53	93.392	88.41	60	0
Student 148	69	83.383	85.53	77.1	0
Student 149	61	89.905	73.95	50.9	0
Student 150	38	90.601	81.36	55.8	0
Student 151	56	95.944	88.25	60	0
Student 152	48	65.862	60.33	35	0
Student 153	55	93.201	79.62	55	0
Student 154	42	70.052	63.7	38.7	0
Student 155	59	93.456	93.46	60	0

engineering students with three fuzzy methods. The success rates of these predictions were as high as following: Classic Fuzzy 72%, Expert Fuzzy 78%, and Gene-Fuzzy 82.50%.

Dülger's 78% success prediction which he made for engineering students' success in Mathematics 1 course in 2013 (Dülger, 2014) and Güner and Çomak's evaluation (2011) indicating the nationwide student selection examination in Turkey (ÖSS) numerical scores, ÖSS math test net correct question numbers and high school academic performance score in Turkey (OOBP) making positive effect on the students' success predictions of Mathematics 1 course have overlapped.

This study was based on determining the susceptibility of students who wish to have a postgraduate education. This research is thought to assist students who need help for the issues they need and for the other support programs that will be considered for applications to postgraduate degrees. In the future, it is foreseen that better results can be obtained and a

more detailed analysis can be made by the help of this set of data, in addition to different effective components of the students, the university entrance exam result, and demographic information of the student.

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