

## FUZZY LOGIC IN LEGAL EDUCATION

Prof. Dr. Z. Gonul BALKIR  
Dean of Law Faculty, Kocaeli University,  
Department of Labor Law  
Umuttepe, Kocaeli, TURKEY

Asist. Prof. Dr. Umit ALNIACIK  
Kocaeli University, Faculty of Communication  
Umuttepe, Kocaeli, TURKEY

Res. Asist. Dr. Eylem APAYDIN  
Kocaeli University, Faculty of Law  
Umuttepe, Kocaeli, TURKEY

### ABSTRACT

The necessity of examination of every case within its peculiar conditions in social sciences requires different approaches complying with the spirit and nature of social sciences. Multiple realities require different and various perceptual interpretations. In modern world and social sciences, interpretation of perception of valued and multi-valued have been started to be understood by the principles of fuzziness and fuzzy logic. Having the verbally expressible degrees of truthness such as true, very true, rather true, etc. fuzzy logic provides the opportunity for the interpretation of especially complex and rather vague set of information by flexibility or equivalence of the variables' of fuzzy limitations.

The methods and principles of fuzzy logic can be benefited in examination of the methodological problems of law, especially in the applications of filling the legal loopholes arising from the ambiguities and interpretation problems in order to understand the legal rules in a more comprehensible and applicable way and the efficiency of legal implications. On the other hand, fuzzy logic can be used as a technical legal method in legal education and especially in legal case studies and legal practice applications in order to provide the perception of law as a value and the more comprehensive and more quality perception and interpretation of value of justice, which is the core value of law.

In the perception of what happened as it has happened in legal relationships and formations, the understanding of social reality and sociological legal rules with multi valued sense perspective and the their applications in accordance with the fuzzy logic's methods could create more equivalent and just results. It can be useful for the young lawyers and law students as a facilitating legal method especially in the materialization of the perception and interpretation of multi valued and variables.

Using methods and principles of fuzzy logic in legal education, more quality and just legal interpretations can be achieved by synchronously dealing with non-contradicting different perspectives of legal realities.

**Keywords:** Fuzzy Logic, Legal Education, principles of fuzzy logic Fuzzy logic, accepting approximate causality has logic, is the expansion of classic set outlook. Use of rules and principles of fuzzy logic as a model of approximate causality in

grading of multi-realities may help in understanding and application of legal reality on a fair and equal level as well as legal education and training.

## INTRODUCTION

Law and legal education is directly related to mathematics and logic as well as all other social sciences. Every new development in social sciences, primarily in logic, has a reflection in law and legal education. This study is a research on fuzzy logic's rules and methods in law and legal practice especially their use in legal education. In this context, fuzzy logic can be effectively used by law students and decision makers as a facilitating legal method in especially concretizing legal perception and interpretation of multi-realities and varieties.

## METHODOLOGY IN LEGAL EDUCATION

Legal methodology is sum of methods whose targets are, besides explaining legal norms, offering solutions to the problem of ensuring the justice providing objective evolution. As general legal knowledge, views of positive law and natural law are regarded in dynamic structure which is a completing each other and transforming to another in time (Güriz, 2003a: 36). As legal practice, positive law is body of laws in force in a certain society within a certain time which can be changed by time. What will be included in positive law is decided by who creates it and when needed it is changed (Aral 2001:44). It is aimed to equate the volition of law maker apparent in Acts with positive law as law in force (Güriz, 2003:380).

To assess the norm carriers and norm designs in law; it is essential to move from idea of abstract justice to idea of concrete justice and behavioural methods. While comprehending the relationship between order, design, and justice, the question on how we realize high justice principle and supremacy of law arises. The arguments need redesigning in this context.

The legal method can be used as a means in changing environment. Law, while running to the concert on the way to be regarded as a science, besides just logical inferences and indications; has started to use induction and deduction and to infer single occasions from a general view (Timucin, 2003: 38). It is crucial for the legal scientists, in the process of production of knowledge, to establish the conditions as systematic rights, which enable them to work in secure, free and responsibly (Okçesiz, 2006:287).

The social reality regarded as source of law form the majority part of existence and it is objective. On the other hand, law is a concept, which is classified by the law maker, indeed the owner of power, as compulsory to comply with and product of its discretionary will. In modern world, law cannot be defined as something different than an order and arrangement liable for the service of justice. On the other hand justice is an objective value placed in the people's consciences (Aral, 2003:19).

Since rules of law are nothing else but solutions to the legal problems, it is duty of legal science to find out whether the social facts and events forming the substance of legal problems considering their bodies and origins are subject to reliable and unalterable natural law and if they are so, to figure out which ways and means are used to solve these issues which are always and universally valid.

Establishing law on the scientific basis depends on human's nature or objects' natures or maybe as a more precise definition, it depends on a synthesis involving the integrity of social human's universal nature and so, legal legitimacy must be sought on this basis and synthesis (Oktem, 2005:33).

The parameter determining the scope and limits of scientific method is its verifiable character via factual ways. Indeed, as characterizing features, science is factual, logical, criticizing, generalizing, and selective (Işıқтаç, 2006:6). Reality exists as a known notion alone and independent from human's mind. Another perception of objectivity is to be generated from the importance of the elimination of subjective elements which blurs our mental perception (Fay, 1996:273).

Rules of deduction method apply to real incidents in social sciences. In social sciences, social structure and society's and nations' situations at the moment or in history are examined by the assistance of other disciplines and general rules are inferred from common features. (Oktem,1985:34). On the other hand, law via norms affects human beings' freedoms and asks them to adapt a certain type of behaviours via imperative norms consisting of propositions, which determine what human beings' behaviours should be. The structures of law and legal norms form the focus of some epistemological discussions (Keyman, 2003:6).

Deterministic rules are dominant in law. It is tried to determine indisputably what a crime is and what is not in law. On the other hand, life and social incidents are based on complications and uncertainty. It is usually impossible to reach the objective truth by interpreting these complications and uncertainty in accordance with the *de lege ferenda* legal rules. One of the most difficult aspects of legal education is to teach law students how to take a right and fair decision in these ambiguities.

## FUZZY LOGIC AND ITS APPLICABILITY

### Definition of Fuzzy Logic

Fuzzy logic, accepting approximate causality has logic, is the expansion of classic set outlook. Decision makers have to fulfil their functions within an ambiguous environment under whatever conditions or extents they decide. The accuracy of the decisions could be maintained as long as the aforementioned uncertainty is converted into minimum risk. Social realities, as they are not based on the absolute distinction and there are thousands of grey tones like absolute black and absolute white in decision making, push us into fuzzy logic rules.

Fuzziness in mathematics means multi-value and its origin relies on the principle of fuzziness of Heisenberg's position and momentum in quantum mechanics. While observing an electron, it is impossible to accurately determine its position and pace at the same time. The mistakes made while measuring these two quantities cannot be kept within acceptable limits. Three valued fuzziness is defined by truth, fallacy, and uncertainty or entity, absence, and uncertainty.

Multi-valued fuzziness corresponds to uncertainty or the degree of uncertainty, and occurrences of incident or relationships (Yakupoglu & et.al., 2010:121). Logic, generally in historical development, is varied as besides Ariosto's syllogism or logic as classic logic, valuable hypothesis logic as classic logic; modes logic, time logic, moral logic, knowledge science logic, choices logic, imperative logic, interrogative logic as extended logics and multi-valued logics; intuitive logics, quantum logics, free logics, inductive logics as contradictory logics.

Theory of fuzzy set is a kind of form and formula of "uncertainty". It is a kind of multi valued set theory. However, its operations differ from the other set theories. Each individual in the set is not deemed a member up to a level not whereas each individual is regarded "a member" or "not a member" in bivalent set theories. For instance, a man, whose height 190 cm, is a member of "tall men" set like a man, 2 meter and 210 cm high. For some reasons, it may not be enough to classify them as "a member" or "not a member".

In these cases, it might be appropriate to identify their membership value by grading to their heights.

Truth in proposition is values in a set including infinite number of values of truth between classic wrong or right or is related to a function correlated to a  $[0, 1]$  (4) real number range as numerical. The fundamental idea behind the fuzzy logic is that a proposition can be right, wrong, very right, very wrong, very very right, very very wrong, approximately right, approximately wrong etc. it is tried to reach a more objective result by qualifying them like this or at least determining statistically.

### Historical Development of Fuzzy Logic

Fuzzy logic and application areas are formed as an alternative to classic set membership and logical thoughts originated from ancient Greek philosophy. The known mathematics models owe their success in large areas to Aristotle and previous thinkers. These thinkers have designed a substantial logic theory and name them laws of thinking. In accordance with these laws something is either right or wrong; it cannot be both right and wrong at the same time (Korner, 1967:415).

While Heraclitus claims the proposition that something can be right and wrong concurrently, Platoon was the first philosopher who indicated the grey area between the right and wrong and destroyed the system of thoughts until then. Later philosophers, especially Hegel, developed Platoon's thoughts by repeating them (McBartney & Odeh,1997: 113).

Combination of Aristotle's logic and Newton's physics caused this system of thought and logic to be preeminent. Every incident occurs as an inevitable consequence of some reasons. Newton's physic is subject to truthful rules of Aristotle's logic. Aristotle's logic and Newton's physic is a world of "either-or". Something is either right or wrong; either black or white; it cannot be both right and wrong because right is one and only. Newton's world view affected not only the psychics, but all the other sciences. Law, social sciences, art, literature, even music, which shaped the modern world, is formed in accordance with the rules of classic physics.

The first alternative systematic proposition to Aristotle's bivalent logic was suggested by Lukasiewicz at the beginning of previous century.

While Jan Lukasiewicz developed the first system of three valued logic early 1930s, later, he generalized the set of truth values to all numbers. Lukasiewicz, making a definition of three values logic, employed a numerical value to the third possibility between the right and wrong. Hence, fundamentals of a system of notation and axiomatic was established in modern mathematics (Yakupoglu & et.al., 2010:122).

While Heisenberg's uncertainty principle forced science into multi-values by continuity of uncertainty, even though a few western philosopher admitted multi-values, Lukasiewicz, Gödel, and Black extended the understanding and perception of contemporary science by developing the first multi-value or fuzzy logic and set systems. Indeed, logical paradoxes and Heisenberg's uncertainty principle causes the development of very valued logical systems in 1920s and 1930s.

Quantum theorists, by adding a third or medium graded truth to right and wrong's set of values in the bivalent logical systems, provide the expression with uncertainty. In the following stage, right and wrong are regarded as the limitations of uncertainty and so certainty gained the opportunity of being graded.

In 1930s, quantum philosopher Max Black, the first man talking about fuzzy set's membership functions, named the uncertainty, which he tried to explain, as haziness by applying the continuous values logic to element levelled sets.

Each element in multi valued sets of Black is, by a sentence in a framework of continuous values logic, equivalent. In 1965, term of fuzzy logic was brought into science world by Azerbaijani Lotfi Zadeh by developing theory of multi valued set and he published a work named "Fuzzy Sets" defining the theory of fuzzy sets and fuzzy sets in maths (Yakupoglu ve ark.2010:123).

The belief of the fact that it was only possible to be black or white, like dead or alive, was only truth was destroyed and instead the reality of that "it is both right and wrong" occurred and it was required to eliminate the view that Aristotle's logic and linear logic was the only truth. Similarly, after quantum physics, involving chaos paradigm and fuzzy logic's multi variable logic formation regarded vague or hazy into mathematics and discovering the principles explaining operations of phenomenon called dynamic systems dislodged the every known value of science world (Alatli, 2001).

### **Applicability of Fuzzy Logic**

Application of artificial intelligence in science world uses multi storey logic structure in the use of case based expert systems. Identical logical structures are used by putting constant rules in the use of these systems. Fuzzy logic rules can be used in the use and interpretation of knowledge, especially knowledge based systems, in the circumstances that knowledge is efficient as a power, in the circumstances that knowledge is required to be dealt with in a better and more detailed way, in the circumstances that use of knowledge has limitations, in the creation of these limitations and in the better and healthier use and comparison of this limited knowledge (Lisalux, 2007).

Fuzzy logic can be used as a system problem solver in a series of problems required human intelligence. This areas include law, chemistry, biology, engineering, manufacturing, aerospace, military operations, finance, banking, meteorology, geology, and more.

Fuzzy logic approach has been started to be used in development of control mechanisms. With systems using fuzzy logic, metro operations are controlled, television receivers adjusted, computers hard disks are controlled, cameras are focused on the vision, air conditions, washing machines, vacuum cleaners are set, freezing in the fridge are prevented, lifts and traffic lights are programmed, cars' engines, suspensions, and brakes are controlled, missiles and concrete mixers are controlled, robots' arms are directed, characters and objects are recognized, golf clubs are chosen even flowers are arranged.

In sum, fuzzy systems consisting of fuzzy logic's principles and methods are already functioning more than they are expected.

For unsolvable problems in expertise areas fuzzy logic makes it possible to reach the result with control data without having the information and reaching the information where it is not possible to reach either real knowledge or reality. Especially in the areas where expert systems require knowledge, it can be used for symbolic representations of knowledge and perform computations through manipulations to reach the results compatible with different symbols and realities (Lisalux, 2007).

## **FUZZY LOGIC IN LEGAL EDUCATION AND TRAINING**

### **A New Research Method in Law: Fuzzy Logic**

In legal education, it is tried to teach what a crime is or not certainly by deterministic rules. Since the legal cases base on complications and uncertainty, to reach the objective truth is usually impossible in accordance with the given legal rules.

Aristotle's logic, depending on one truth in understanding and analysis of legal realities, which depend on multi values and virtues, is not sufficient and furthermore, it manipulates the justice and causes injustice and unequal results.

A method of new and multi valued causality is required in order to provide an efficient and healthy assessment of uncertainty and complication of social incidents. Fuzzy logic can be used as a modern method in the analysis of legal incidents and legal applications in order to ensure those especially young lawyers and law students and the persons who are under responsibility to take decisions would decide securely with minimum risk.

The reality named as law is an issue created by human beings' volition rather than an independent matter from the human beings' will like physical matters. Hence the duty of law is to research and find the intersection point between the "legal", meaning procedural validity and value. Therefore, we have to benefit modern research methods in dealing with absolute justice and problem of truth. One of the recent research methods awaiting time and place to be used and benefited in this context is the principles and rules of fuzzy logic.

It has been asserted that rules of fuzzy logic, which has been intensively worked in the last 20 years, can be used in legal applications. Fuzzy logic emerges as a body of rules which would enable the decision makers in legal matters embracing multi dimensional mechanisms to decide comparatively by reaching a series of values.

Since decisions need to be made in line with the legal regulations formed by legal rules when trying to maintain the superiority of law, how is equality maintained in determining the responsibility in multiple persons, multiple incidents and multiple realities when deciding on aggravating and mitigating factors related to incidents and intents? When using such discretion, aggravating and mitigating constituents and elements should be taken into consideration so that a balanced and fair decision can be made and thus, equality and justice can be maintained.

Fuzzy logic's rules may be adapted in interpretation of complicated and multi realities and comparison of applied science values and an opportunity to decide fairer and more equal may rise without eliminating the outer realities. In such combinations, it may provide an efficient interpretation. Similarly, fuzzy logic's rules may create the control efficiency in determination of gravity of reality.

It may provide the capability to interpret the human's behaviours in the complex perception and interpretation of legal realities (MacGill, 2010). Where the sources of knowledge are not reachable or the true knowledge cannot be known, fuzzy logic can be used a model of reasonable implication and a different computation element for the decision makers who have to decide with insufficient knowledge (Lisalux, 2007).

They are among the question needing answers to what extent fuzzy logic with the hope to provide a healthier decision making process with parameters, and realistic and previously known comparisons for the decision makers in the realities concerning multi decision mechanisms can be used in legal applications or how consistent they can be used, and whether it can bring a new modelling or whether it can provide a coherent solutions to the legal matters.

### **Fuzzy Logic in Legal Education**

Law is the accumulation of behavioural rules of the society that we live in. Especially in multi-realities in the law's own areas where summarised problems provide limited solutions it could contribute and be useful in the border areas, however restricted.

Fuzzy logic could be applied as a new legal analysis approach, especially in the concepts with multi-realities, in particular due to its capacity to be employed in the resolution of attribute valuation problems where answers beyond 'yes' and 'no' are sought. Since decisions need to be made in line with the legal regulations formed by legal rules when trying to maintain the superiority of law, how is equality maintained in determining the responsibility in multiple persons, multiple incidents and multiple realities when deciding on aggravating and mitigating factors related to incidents and intents? When using such discretion, aggravating and mitigating constituents and elements should be taken into consideration so that a balanced and fair decision can be made and thus, equality and justice can be maintained.

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Where the sources of knowledge are not reachable or the true knowledge cannot be known, fuzzy logic can be used a model of reasonable implication and a different computation element for the decision makers who have to decide with insufficient knowledge (Lisalux, 2007). It is apparent that fuzzy logic and its rules can be employed as a useful method in decision making process by setting a new mathematics and logical models in legal education. Rules of fuzzy logic provide a comparison including enlightening quality and quantity models as statistical data. At this stage, the question of how fuzzy logic rules can be applied rises. In this context, fuzzy logic may have three different application areas in legal education and applications.

Initially, fuzzy logic's rules can be used in assessment of macro sizes in legal analysis. Definition of system changes, usability and simplicity of use in them show the plausibility of fuzzy logic. Hence, it is apparent that fuzzy logic's rules have a valid applicability in law, even though it is limited. Another use of fuzzy logic in legal education is that rules of fuzzy logic are used as metaphorical. The third type of use is that they create an opportunity for the decision makers to infer normative results by analogies for the multi realities. It seems that rules of fuzzy logic can be used as an objective and efficient device in the use of discretion of decision makers where circumstances require a multi options decisions. With this format, fuzzy logic can be accepted as a new model in law.

Definition of system changes, usability and simplicity of use in them show the plausibility of fuzzy logic. It seems that rules of fuzzy logic can be used as an objective and efficient device in the use of discretion of decision makers where circumstances require a multi options decisions. Rules of fuzzy logic provide a comparison including enlightening quality and quantity models as statistical data. Fuzzy logic provides an opportunity to focus on grey instead of black and white in critic point analysis. Where there are complicated crime, damage, and compensation cases including multi persons and actions, fuzzy logic can be used and applied in determination of responsible persons, in calculation of amounts of multi compensations, in making and providing the distribution of justice and legal equality to many people, in providing the fair and equal multi solutions to unequal treatments offered to people as public benefits and services and the distribution of inequality fairly, especially distribution of income, education, access to health etc., and in the complications consisting of people and incidents. With this format, rules of fuzzy logic can be accepted as a new and modern legal method in legal education.

## CONCLUSION

Fuzzy logic, accepting approximate causality has logic, is the expansion of classic set outlook. Use of rules and principles of fuzzy logic as a model of approximate causality in grading of multi-realities may help in understanding and application of legal reality on a fair and equal level as well as legal education and training. In this context, fuzzy logic can be efficiently used by law students and decision makers as a facilitating legal method especially in the materialization of the perception and interpretation of multi valued and variables.

Fuzzy logic creates an opportunity to interpret especially the complicated and partially uncertain knowledge sets' variables with fuzzy limitations in flexibility or balance by having the truth degrees, which can be verbally expressed as right, very right, not that right etc. Fuzzy logic can be used as a technical legal method in legal education and especially in legal case studies and legal practice applications in order to provide the perception of law as a value and the more comprehensive and more quality perception and interpretation of value of justice, which is the core value of law. The methods and principles of fuzzy logic can be benefited in examination of the methodological problems of law, especially in the applications of filling the legal loopholes arising from the ambiguities and interpretation problems in order to understand the legal rules in a more comprehensible and applicable way and the efficiency of legal implications.

## BIODATA and CONTACT ADDRESSES of AUTHORS



Zehra Gonul Balkir was born in Istanbul in 1956. After leaving Izmit High School, she graduated from the University of Istanbul Faculty of Law in 1978. While she was working as an attorney at law between 1979-1994, she continued firstly her master studies between 1983-1985 and then her PhD studies at the University of Istanbul between 1986-1989. Having participated in the foundation of University of Kocaeli as a founder member with the title of assistant professor, she moved to the academic life in 1994. While she was acting as the Deputy Dean between 1994-2000, she gained title of Docent (Associate Professor) in the area of Labour Law and Social Security Law in 2000. She worked as the director of University of Kocaeli Kandira Vocational High School between 2001-2006. She was appointed as professor of Labour Law and Social Security Law and dean of Faculty of Law in 2006. She is still at these positions.

Researching on Labour Law and Social Security Law, Law of Earthquake, Law of Architecture, Women's Rights and Women Labour Law, and Legal Philosophy, Z. Gonul Balkir has published books named as "Disables' Participation in Working Life", "Social Rights in Constitutional Procedures", "Architectural Labour Law", "Development of Non-Governmental Organizations". Besides, she has made numerous presentations in national and international conferences, and has published many articles in local and national journals.

Prof. Dr. Z. Gönül BALKIR  
Dean of Law Faculty,  
Department of Labor Law  
Kocaeli University,  
Umuttepe, Kocaeli, TURKEY  
Tel: 0 532 324 89 00  
Fax:0 262 303 26 03  
Email: [gonulbalkir@yahoo.com](mailto:gonulbalkir@yahoo.com)



Umit Alniacik, who was born in Izmit in 1977, graduated from Kocaeli University, Faculty of Economics and Administrative Sciences, Department of Business Administration and gained his BA degree in 1999. He was awarded a MA degree on marketing from Kocaeli University, Institute of Social Sciences in 2003. He received his PhD in Business Administration from Gebze Institute of Technology's Institute of Social Sciences in 2009. Between 2005-

2010 he worked as a lecturer at Gebze Institute of Technology's Department of Science of Strategy. He works as a Assist.Prof.Dr. at the Department of Advertising of Kocaeli University since 2010. His main areas of research are advertising effectiveness, consumer behavior, social marketing, corporate social responsibility.

Asst. Prof. Dr. Umit ALNIAÇIK  
Kocaeli University,  
Faculty of Communications, Department of Advertising  
Umuttepe, Kocaeli, TURKEY  
Tel: +90 262 3031884  
Fax: +90 262 3031803  
Email: [umit.alniacik@kocaeli.edu.tr](mailto:umit.alniacik@kocaeli.edu.tr)



Dr. Eylem Apaydin, who was born in Kirsehir in 1979, left Kirikkale Anatolia Teacher High School in 1996 and graduated from University of Ankara Faculty of Law in 2000. He completed his legal practice training in Ankara Bar Association in 2001. While he was working as a Candidate Judge in Ankara Courts, he went to the UK for higher education purposes thanks to his scholarship granted by the Ministry of National Education. He was granted his LLM degree from the University of Kent in 2004 and his PhD award from the University of Leicester in 2010.

Dr. Eylem Apaydin has been working as a researcher at the Department of Civil Law at the University of Kocaeli Faculty of Law. Dr. Apaydin, maintaining his research on all areas of civil law, is expert on International Contract Law, Co-ownership and Trust Law.

Res. Asist. Dr. Eylem APAYDIN  
Kocaeli University, Faculty of Law  
Umuttepe, Kocaeli, TURKEY  
Tel: 05077468810  
Fax: 0 262 303 26 03  
Email: [eyapaydin@yahoo.com](mailto:eyapaydin@yahoo.com)

## REFERENCES

Aral, V. (2003). Hukuku Bilim Yapan Nedir? [What Makes Law a Science], *HFSA 6*, Istanbul, 19–20, Turkey.

Aral, V. (2001). *Hukuk ve Hukuk Billimi Üzerine [About Law and Legal Science]*, Istanbul, 44-45, Turkey.

Güriz, A. (2003a). *Hukuk Başlangıcı [Introduction to Law]*, Ankara, 36, Turkey.

Güriz, A. (2003b). *Hukuk Felsefesi [Legal Philosophy]*, Ankara, 380, Turkey.

Keyman, S. (2003). Hukuk Felsefesinin Konusu [Subject of Legal Philosophy], HFSA 6, Istanbul, 6, Turkey.

Korner, S. (1967). Laws of thought. In: *Encyclopedia of Philosophy*, Vol. 4. MacMillan, New York, 414-417, USA.

McBratney, A. B., & Odeh, I. O. A. (1997). Application of fuzzy sets in soil science: Fuzzy logic, fuzzy measurements and fuzzy decisions. *Geoderma* 77: 85- 113.

Okçesiz, H. (2006). Hukuk ve Bilimi [Law and Legal Science], HFSA 15, Istanbul 2006, 287, Turkey.

Oktem, N. (2005). Hukukun Bilimselliği [Scientific of Law], HFSA 11, Istanbul, 33, Turkey.

Oktem, N. (1985). *Hukuk Felsefesi ve Hukuk Sosyolojisi [Legal Philosophy and Legal Sociology]*, Istanbul, 15, Turkey.

Timucin, A. (2003). *Estetik [Aesthetics]*, Istanbul, 36, Turkey.

Isıktac, Y. (2006). *Hukuk Felsefesi [Legal Philosophy]*, Istanbul , 6.

Fay, B. (1996). *Çağdaş Sosyal Bilimler Felsefesi [Philosophy of Modern Social Sciences]*, Istanbul, 273-275, Turkey.

Zadeh, L. A. (2004). A note on web intelligence, world knowledge and fuzzy logic. *Data & Knowledge Engineering*. 50: 291-304.

Alatlı, A. (2001). "İkinci Aydınlanma Çağında Yeni Hukuk Anlayışı [New Legal Concept in the Second Enlightenment Era]", 4th December 2001, [http://www.onarimcilar.net/j/index.php?option=com\\_content&task=view&id=50&Itemid=8](http://www.onarimcilar.net/j/index.php?option=com_content&task=view&id=50&Itemid=8) retrieved on 26. 06.2010.

Lisalux, (2007). Artificial Intelligence and the Chaos Theory, <http://www.echeat.com/essay.php?t=32283> retrieved on 26. 06.2010.

MacGill, V.(n.d.)."A non-technical introduction to the new science of Chaos and Complexity", <http://complexity.orconhosting.net.nz/fuzzy.html> retrieved on 25. 06.2010.

Yakupoglu & et.al. (2010). "Toprak Erozyonu Çalışmalarında Bulanık Mantık Uygulamaları [Fuzzy Logic Applications in Soil Erosion Researches]", <http://www.petrdoostal.eu/papers.html> retrieved on 26. 06.2010.