Journal of Theoretical and Applied Information Technology
15th July 2021. Vol.99. No 13

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

THE APPLICATION OF FUZZY LOGIC TO IMPROVE ORIENTATION IN SYSTEM EDUCATION IN MOROCCO.

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ABSTRACT

The aim purpose of this research that we realized in this study is to determine the best orientation of the student after his high school while dealing with the problem of uncertainty and ambiguity and applying fuzzy logic theory at an university located in Casablanca in Morocco. Firstly, we introduce the importance of education, and then we present the theory of fuzzy logic, its inference system and its state of the art. Secondly, we present the criteria that we choose for our research which are: "Grades, “Motivation” and “Communication”, and the output which is “Orientation”. Next, we do the fuzzification for the three criteria chosen. Moreover, we construct fuzzy-rule. Then we apply defuzzification: We acquire diagrams and graphs which explain to us according to the chosen situation the determination of the best orientation according to each case which can be presented to the decision makers. We then compare our research to other research carried out in the education sector, specifying the difference in objectives. Finally we end by presenting the efficiency of the application of the fuzzy logic method for this study and we mention some of its limitations.
Keywords: *Fuzzy Logic, Orientation in Morocco, Motivation, Grades, Communication*

1. INTRODUCTION

According to Michaelowa [1] productivity gains increase by increasing individual incomes through whether these people have an education or at least have learned from educated people. Aghion et al. [2] also cite that education has enormous benefits such as improving human health, and spreading equality which is important to society. Seetanah [3] asserts that by encouraging people to be educated they will therefore be part of the active people who produce what makes the economy grow. According to Barro [4] education has the enormous benefit of making the economy grow and change human life for the better by increasing individual income and encouraging the efficiency of the labor force.

Indeed, at the higher educational level, Morocco as an African country has carried out enormous reforms to progress such as confirmed by Tawil et al. [5] and [6]:

- Allow a facility for the mobility of students, teachers, researchers and administrative staff;
- Help Moroccan graduates to access the world of work in Europe;
- Allow higher education to be more and more professional
- Facilitate the equivalence of diplomas at the international level.

Higher education in Morocco follows the LMD system with license, master and doctorate (Bac + 8), comprising semesters composed of teaching units as shown in the following diagram [7] :

The figure below presents the LMD system:

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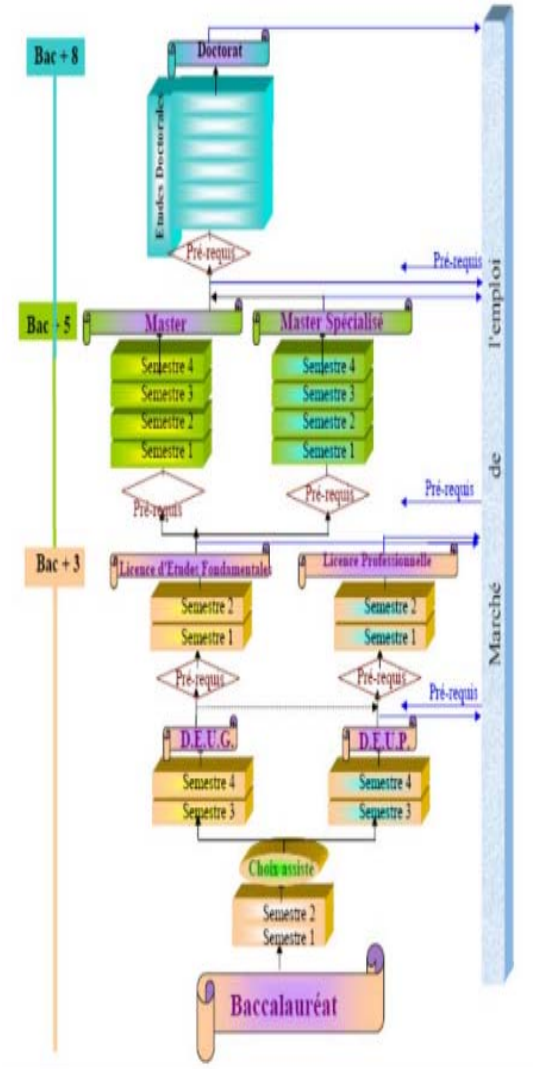

Figure 1: The LMD system [7]

From the above, how can we implement fuzzy logic to help decision makers in university and counselors to better guide and orient students and young people before starting their new academic year?

In terms of knowledge, we contribute to the education sector by proposing a new multi-criteria assessment method called fuzzy logic for the guidance of students before integration into university. This creates some added value in the education sector as it is a scientific assessment method and Moroccans generally do not use scientific methods to guide students. The use of this scientific method which is fuzzy logic requires scientific expertise, and I as a scientific researcher could apply this approach in the education sector, which requires following its steps carefully.

2. METHODOLOGY

For this piece of work, here is the methodology we conducted in order to achieve the purpose of this research:

First, we present the theory of fuzzy logic, its system of inference, and its state of the art. Then in the case study, we follow the next steps:

1. We collect the necessary information from decision makers and we present the chosen criteria
2. This is the fuzzification stage: We determine the linguistic values of the selected criteria which are the inputs and also for the output which is Orientation and we model them all by the membership function.
3. It is the stage, we do the construction of the rules based on the opinion of the decision makers.
4. This is the Defuzzification stage: the fuzzy values are converted to crisp values.

The procedure applied in our research is applied in Figure below:

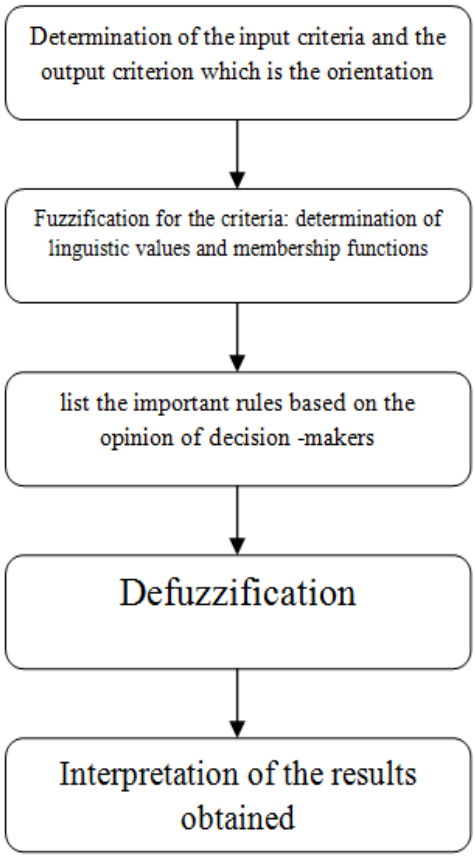

Figure 2: The procedure applied in our research

Finally, in the section: Discussion, we present the advantages of applying the fuzzy logic for our research and we will present the merits and demerits of the applied method.

3. RESULTS

3.1 Fuzzy logic

Zadeh [8] introduced the theory of fuzzy logic which was able to resolve and give a simple conclusion in the face of uncertainty, ambiguity, imprecision in human thought. The introduction of fuzzy sets have helped to model the real world while taking into account the subjectivity that exists in human thinking or the uncertainty or ambiguity in determining an exact value (Pal and Bezdek [9].

The fuzzy logic approach has been used in several fields and research for decision making: Patra and Mondal [10] use fuzzy logic for fuzzy risk analysis studied by possibility and necessity constraints for multi-item supplier selection model. Fuzzy-logic method was combined with AHP and used by chen [11] in order to improve the decision. Fayek [12] describes the important role of fuzzy logic that it plays in many engineering and construction management applications. Alalaya et al. [13] combined the fuzzy logic method with Neural Network Models to Predict Amman Stock Exchange. Elbarkouky et al. [14] utilized Fuzzy arithmetic risk analysis approach to determine construction project contingency. Hüllermeier [15] did a great search titled: Does machine learning need fuzzy logic? Fuzzy-logic was combined with AHP and used by Nguyen et al. [16] in order to do applications in evaluating construction project complexity. Ouma & Hahn [17] have applied fuzzy c-means clustering and morphological reconstruction Pothole detection on asphalt pavements from 2D-colour pothole images. Siraj and Fayek [18] conducted research based on Fuzzy system dynamics for modeling construction risk management. Tabaraee et al. [19] Evaluated power plants to prioritize investment projects using the fuzzy PROMETHEE method. Tsehayae and Fayek [20] conducted a research based on the fact of Developing and optimizing context-specific fuzzy inference system-based construction labor productivity models. Bouzoubaa et al. [21] used Fuzzy Logic concepts for Innovative maintenance model.

We present in this table below the Advantages of fuzzy logic approach:

Table 1: Some main advantages Advantages of fuzzy logic approach [22)[23][24] [25]

Fuzzy Logic Method	Advantages
Advantage 1	This approach makes it possible to reason like a human being, which is beneficial for decision-makers and for decision-making
Advantage 2	The method is simple and uses the linguistic model.
Advantage 3	This approach does not require a lot of mathematical calculation, which allows quick results.
Advantage 4	The method gives a clear vision and analyzes the reaction of the system to the various situations presented to the decision-makers, which allows a rapid decision.

The structure of a Fuzzy Logic System is in the figure below:

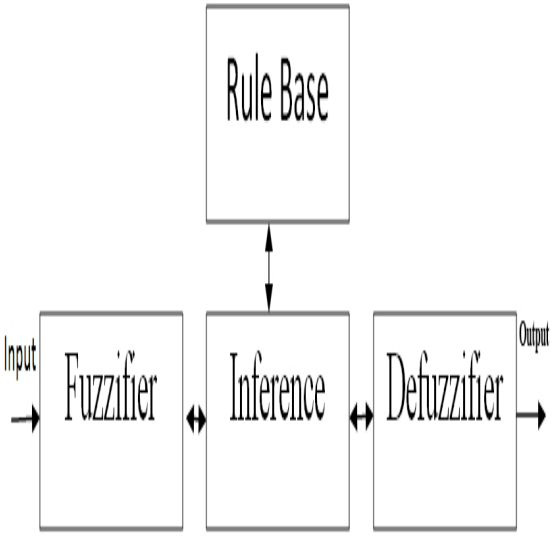

Figure 3: Structure of a Fuzzy Logic system [26]

3.1.1 The fuzzifcation

According to Zadeh [27]: The fuzzifcation consists first of all in converting from a numerical value to a completely fuzzy value using Knowledge or Rule base based on membership functions such as trapezoidal functions or triangular functions as shown in the figure below:

We do also a definition of membership functions of all variables that we have in our study.

The figure below shows an example of triangular membership function

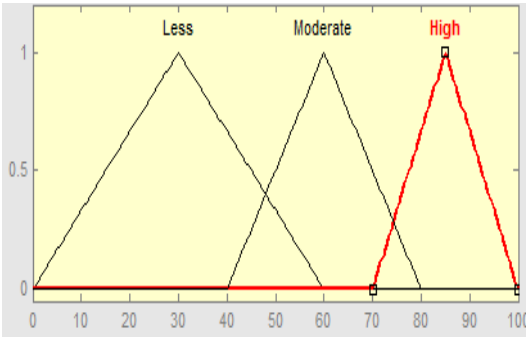

Figure 4: triangular membership function

The figure below shows an example of trapezoidal membership function:

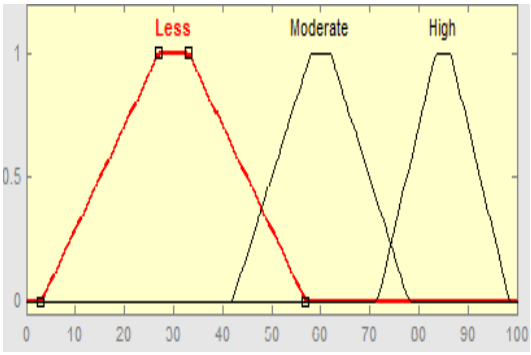

Figure 5: Example of trapezoidal Membership function

The figure below shows an example of guassian membership function:

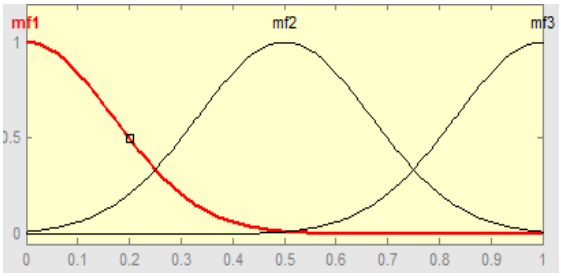

Figure 6: Example of guassian Membership function

3.1.2 The Rule Base

According to Zadeh [27], this is where we define the fuzzy rules: Using the intuition of decision-makers and managers we can list a set of established rules in the form:

If (condition), then (a conclusion)

For example: If the student has a good mark in the baccalaureate and is well motivated, then he will be well oriented towards the course which suits him the most.

Example: If the patient takes his medications prescribed by the doctor, he will be completely cured

3.1.3 The Inference

According to Zadeh [27], in this step, each rule is evaluated individually and logical operators like AND "," OR "and" NOT "define how fuzzy variables are combined for that rule and the result is a set of fuzzy decisions [28].

3.1.4 Defuzzification

According to Zadeh[27], the last step is Defuzzification, it is a reverse conversion to the process of fuzzifcation, because in this process the fuzzy output is converted to crisp values to be applied to the system.

The widely used method that we will apply in this piece of research is the center of surface method which takes the center of gravity of the fuzzy set Lee [29]

3.4 Case Study:

We had a meeting with the officials and decision-makers of the university which determined us the important criteria for a better orientation.

3.4.1 Presentation of criteria

Orientation: A good orientation helps students to explore new professions, to help young people find the best graduate school, namely that this support can greatly influence the results of the students [30]. According to Gass [31], before starting university studies, and to avoid failure, students must be well oriented because a transitional and very important year. Collins [32] asserts that there is an orientation program while taking into consideration what the students feel and taking into account their aspirations and meeting their expectations.

Communication: According to the Cambridge dictionary: “Communication is also the exchange of information and the expression of feeling that can result in understanding” [33]. Genç, [34] says communication is essential in every area of life, from home to work. For example, in medicine, it is important for the management of postoperative pain and communication between the patient and the doctor facilitates the detection of the disease Sugai et al. [35]. Communication is very vital within a company and for a business because it facilitates the flow of information, motivation and mutual understanding Genc [36].

Motivation : Steinmayr & Spinath [37] shows in his research the importance of motivation as a predictor of school achievement. A tool frequently used in the context of research on motivation for success called: the Achievement Motives Scale by Gjesme and Nygard [38]. Anjomshoa & Sadighi [39] indicate that the person can be internally motivated by wanting / loving to achieve this thing or externally as the fact that this

student for example is motivated by his family and his entourage.

Grades: This is what the student had as a final grade before entering a university.

Now, we will start the first step of fuzzy logic.

3.4.2 Fuzzification of criteria

3.4.2.1 Fuzzification for Grades

The table below shows the fuzzification for Grades:

Table 2: Range for Grades

Fuzzy	Variable	Range
1	low	0-60
2	Medium	55-70
3	High	65-100

The figure below shows the membership function was used for Grades:

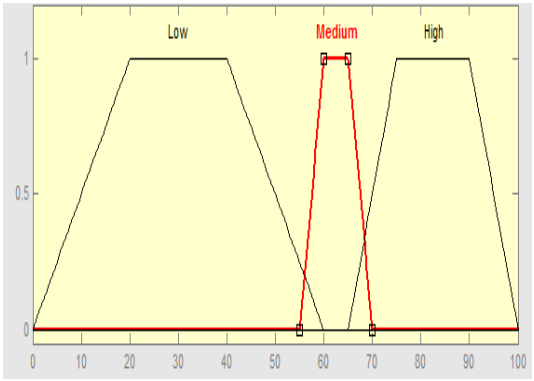

Figure 7: The membership function of Grades

3.4.2.2 Fuzzification for Communication

The table below shows the range of communication.

Table 3: Range for communication

Fuzzy	Variable	Range
1	Bad	0-50
2	Average	40-70
3	Good	60-100

The figure below shows the membership function was used for Communication:

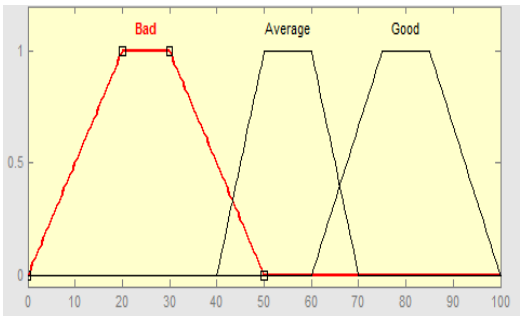

Figure 8: The membership function of Communication

3.4.2.3 Fuzzification for Motivation

The table shows the range for motivation:

Table 4: Range for Motivation

Fuzzy	Variable	Range
1	Bad	0-60
2	Average	50-80
3	Good	70-100

The figure below shows the membership function was used for Motivation:

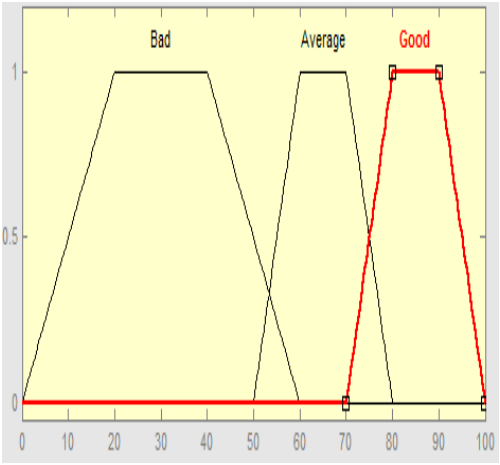

Figure 9: The membership function of Motivation

3.4.2.4 Fuzzification for Orientation

The table below shows the range of Orientation.

Table 5: Range for Orientation

Fuzzy	Variable	Range
1	Bad	0-55
2	Average	50-80
3	Good	70-100

The figure below shows the membership function was used for Orientation:

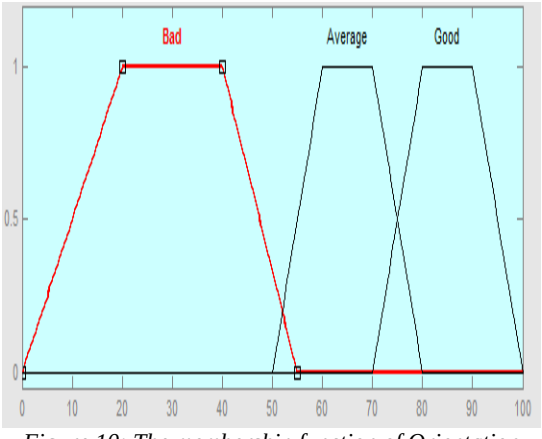

Figure 10: The membership function of Orientation

Journal of Theoretical and Applied Information Technology
15th July 2021. Vol.99. No 13

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

3.4.3 Rule base and inference of criteria

We construct Fuzzy Rule when Grades is low.

The table below shows the Fuzzy Rule when Grades is low; "C" is the abbreviation of Communication in the table.

Table 6: Fuzzy Rule when Grades is low

C / Motivation	Bad	Average	Good
Bad	Bad	Bad	Average
Average	Bad	Bad	Average
Good	Bad	Bad	Average

We construct Fuzzy Rule when Grades is Medium.

The table below shows the Fuzzy Rule when Grades is Medium; "C" is the abbreviation of Communication in the table.

Table 7: Fuzzy Rule when Grades is Medium

C / Motivation	Bad	Average	Good
Bad	Bad	Average	Average
Average	Average	Average	Average
Good	Average	Average	Good

We construct Fuzzy Rule when Grades is High.

The table below shows the Fuzzy Rule when Grades is High; "C" is the abbreviation of Communication in the table.

Table 8: Fuzzy Rule when Grades is High

C / Motivation	Bad	Average	Good
Bad	Bad	Average	Good
Average	Average	Good	Good
Good	Good	Good	Good

We get 27 rules as shown by the Matlab software:

1. If (Grades is Low) and (Communication is Bad) and (Motivation is Bad) then (Orientation is Bad) (1)
2. If (Grades is Low) and (Communication is Bad) and (Motivation is Average) then (Orientation is Bad) (1)
3. If (Grades is Low) and (Communication is Bad) and (Motivation is Good) then (Orientation is Bad) (1)
4. If (Grades is Low) and (Communication is Average) and (Motivation is Bad) then (Orientation is Bad) (1)
5. If (Grades is Low) and (Communication is Average) and (Motivation is Average) then (Orientation is Bad) (1)
6. If (Grades is Low) and (Communication is Average) and (Motivation is Good) then (Orientation is Bad) (1)
7. If (Grades is Low) and (Communication is Good) and (Motivation is Bad) then (Orientation is Average) (1)
8. If (Grades is Low) and (Communication is Good) and (Motivation is Average) then (Orientation is Average) (1)
9. If (Grades is Low) and (Communication is Good) and (Motivation is Good) then (Orientation is Average) (1)
10. If (Grades is Medium) and (Communication is Bad) and (Motivation is Bad) then (Orientation is Bad) (1)
11. If (Grades is Medium) and (Communication is Bad) and (Motivation is Average) then (Orientation is Average) (1)
12. If (Grades is Medium) and (Communication is Bad) and (Motivation is Good) then (Orientation is Average) (1)
13. If (Grades is Medium) and (Communication is Average) and (Motivation is Bad) then (Orientation is Average) (1)
14. If (Grades is Medium) and (Communication is Average) and (Motivation is Average) then (Orientation is Average) (1)
15. If (Grades is Medium) and (Communication is Average) and (Motivation is Good) then (Orientation is Average) (1)
16. If (Grades is Medium) and (Communication is Good) and (Motivation is Bad) then (Orientation is Average) (1)
17. If (Grades is Medium) and (Communication is Good) and (Motivation is Average) then (Orientation is Average) (1)
18. If (Grades is Medium) and (Communication is Good) and (Motivation is Good) then (Orientation is Good) (1)
19. If (Grades is High) and (Communication is Bad) and (Motivation is Bad) then (Orientation is Bad) (1)
20. If (Grades is High) and (Communication is Bad) and (Motivation is Average) then (Orientation is Average) (1)
21. If (Grades is High) and (Communication is Bad) and (Motivation is Good) then (Orientation is Good) (1)
22. If (Grades is High) and (Communication is Average) and (Motivation is Bad) then (Orientation is Average) (1)
23. If (Grades is High) and (Communication is Average) and (Motivation is Average) then (Orientation is Good) (1)
24. If (Grades is High) and (Communication is Average) and (Motivation is Good) then (Orientation is Good) (1)
25. If (Grades is High) and (Communication is Good) and (Motivation is Bad) then (Orientation is Good) (1)
26. If (Grades is High) and (Communication is Good) and (Motivation is Average) then (Orientation is Good) (1)
27. If (Grades is High) and (Communication is Good) and (Motivation is Good) then (Orientation is Good) (1)

Figure 11: Rules by Matlab

4. DISCUSSION

We will begin the study and interpretation of the graphs, after defuzzification, while taking into account the orientation of the students according to the three criteria chosen in this piece of research which are: the criteria: "Grades", the criterion: "Communication" and finally the criterion: "Motivation"

Important special cases that can be treated:

Case 1: One indicator is fixed and two indicators are changed

Case 2: Two indicators are fixed and one indicator is changed

4.1 One indicator is fixed and two are changed

Example 1:

- ✓ One indicator is fixed: "Communication" as average 60
- ✓ Two are changed: "Motivation" and "Grades "

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15th July 2021. Vol.99. No 13

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

We will analyze the reaction of our system if we give an average value to the "communication" indicator (60). We will see how the "Orientation" indicator output will vary according to the two remaining inputs which are "motivation" and "Grades" and how they impact it.

The figure below shows the Surface viewers of example N°1:

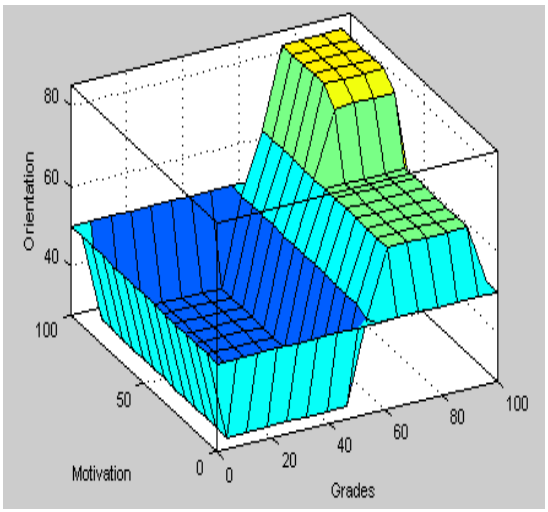

Figure 12: The Surface viewers of example N°1

Discuss curve of the example N°1:

The curve above shows that we can see the three results of the orientation:

- ✓ The first result which is bad Orientation is where Grades is Low regardless of whether the motivation is bad or average or high.
- ✓ The second situation is the case where the "Orientation" criterion is Average. This situation is characterized by the fact that the "Grades" criterion is average regardless of the motivation criterion whether it is bad, average or good "
- ✓ The last situation represents the case where the orientation criterion is Good. This case occurs when we have a "Grades" criterion is high and the motivation criterion is.

As we can see from the figure below, when the motivation is average or Good, Grades is High, that gives us a Good Orientation.

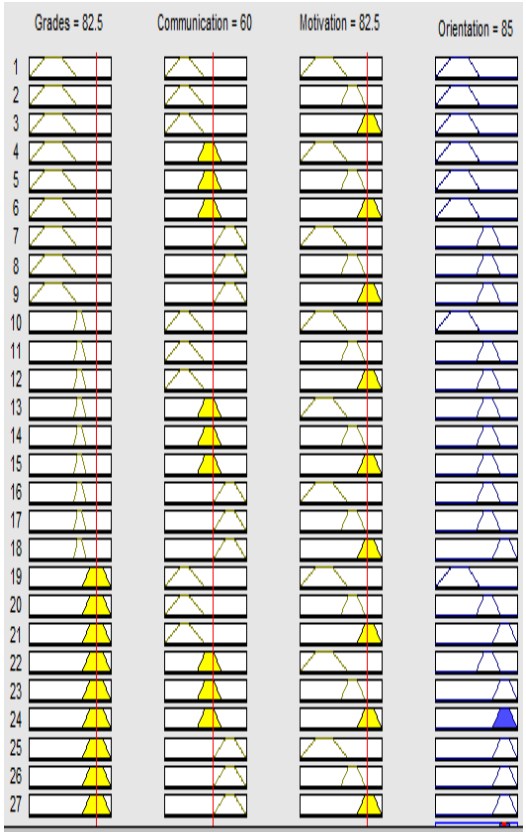

Figure 13: Rules View for "Grades" and "Motivation" when communication is fixed at 60

When we set the criterion Communication, it is mainly the criterion Grades which is important to determine the orientation of the student.

Example 2:

- ✓ One indicator is fixed: "Motivation" as average 60
- ✓ Two are changed: "Communication" and "Grades "

We will analyze the reaction of our system if we give an average value to the indicator "Motivation" (60). We will see how the "Orientation" indicator will vary according to the two other inputs: "Communication" and "Grades".

The figure below shows the Surface viewers of example N°2:

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ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

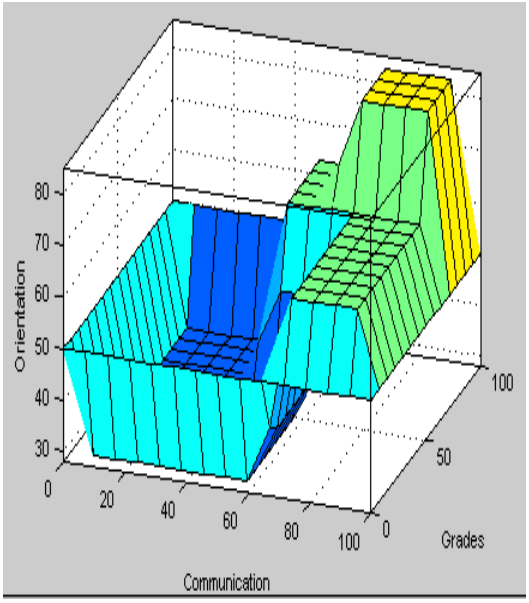

Figure 14: The Surface viewers of example N°2

The curve above shows that we can see the three results of the orientation:

- ✓ The first result which is bad "Orientation" is where" communication "is Bad regardless of whether the Grades is bad or average or high.
- ✓ The second situation is the case where the "Orientation" is Average. This situation is characterized by the fact that the "communication " criterion is average regardless of the Grades criterion whether it is low, Medium or High "
- ✓ The last situation represents the case where the orientation criterion is Good. This case occurs when we have a "Grades" criterion is high and the communication criterion is good.

As we can see from the figure below, when Rules View for Grades and Communication when motivation is fixed at 60

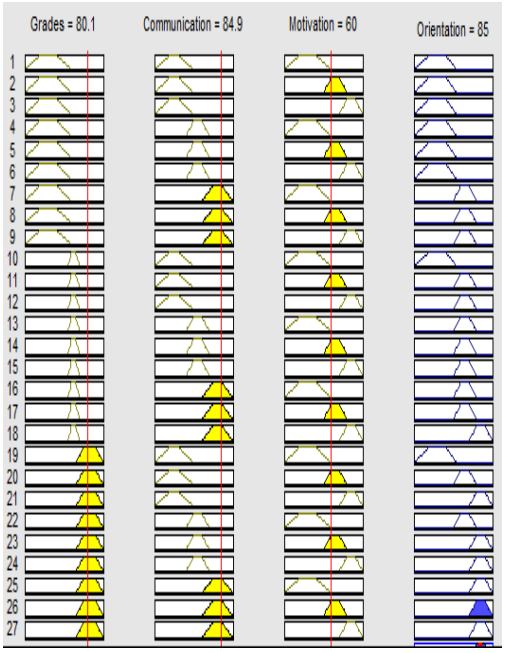

Figure 15: Rules View for Grades and Communication when motivation is fixed at 60

Example 3:

- ✓ One indicator is fixed: "Grades" as Medium 65
- ✓ Two are changed: "Communication" and "Motivation "

We will analyze the reaction of our system if we assign an average value to the indicator "Grades" (60). We will see how the output of the "Orientation" indicator will vary depending on the other two inputs which are "Communication" and "Motivation".

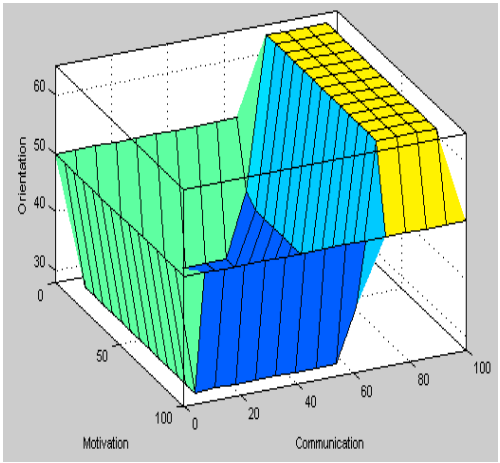

Figure 16: The Surface viewers of example N°3

- ✓ The first result which" Orientation" is bad is where "Communication "is bad

regardless of whether the motivation is bad or average or good.

- ✓ The second situation is the case where the "Orientation" is Average. This situation is characterized by the fact that the "Communication" criterion is good regardless of the motivation criterion whether it is bad, average or good "

As we can see from the figure below, when Rules View for Grades and Communication when motivation is fixed at 60

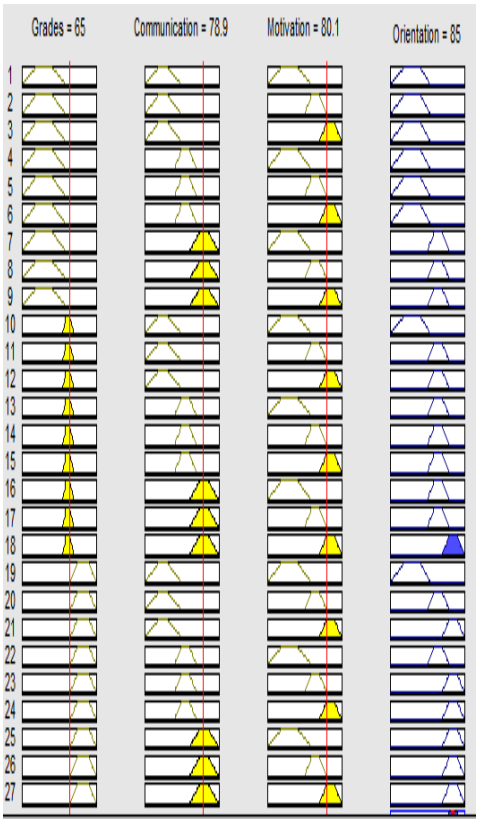

Figure 17: Rules View for Motivation and Communication when Grades is fixed at 65

We conclude that in the case where we set "Grades", it is the communication criterion that determines the nature of the orientation anyway for the motivation criterion which can be bad, average or good.

4.2 Two indicators are fixed and one is changed

Example 4: We set the criterion of "Motivation" and the criterion of "Communication" at the value 80.

The table below shows the change of orientation with Grades:

Table 9: The change of orientation with Grades

Grades	Orientation
1	65
10	65
20	65
30	65
40	65
50	65
60	85
70	85
80	85
90	85
95	85

The figure below shows the change of orientation with Grades

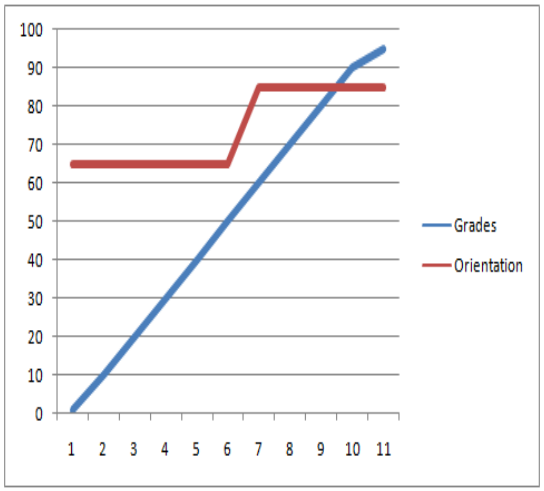

Figure 18: The curve of the example N° 4

Discuss the curve of the example N°4:

Initially, the value of the "Orientation" is fixed at 65 despite the fact that the parameter: Grades increases linearly. Then the value of the Orientation also increases linearly between the interval [65- 50] with the Grades. The value of the Orientation remains fixed again at the value 85 despite the linear increase in Grades.

Example 5: We set the criterion of "Grades" and the criterion of "Communication" at the value 80

The table below shows the change of orientation with Motivation.

Table 10: The change of orientation with Motivation

Motivation	Orientation
1	85
10	85
20	85
30	85
40	85
50	85
60	85
70	85
80	85
90	85

95	85

The figure below shows the change of orientation with Motivation

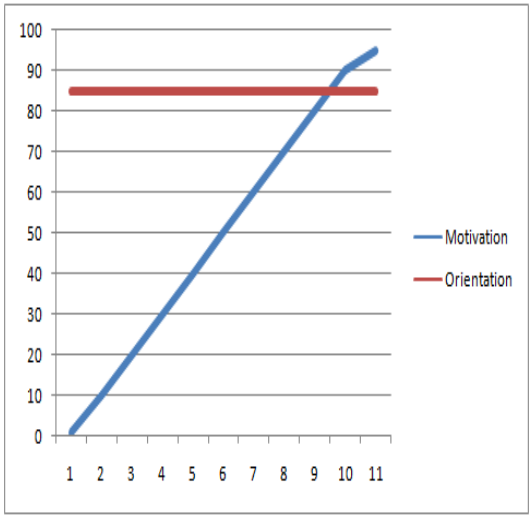

Figure 19: The curve of the example N° 5

Discuss the curve of the example N°5:

The value of the orientation remains fixed at value 85, despite the fact that the parameter: Motivation increases linearly.

Example 6:

We set the criterion of "Grades" and the criterion of "Motivation" at the value 80.

The table below shows the change of orientation with Communication:

Table 11: the change of "Orientation" with Communication

Communication	Orientation
1	85
10	85
20	85
30	85
40	85
50	85
60	85
70	85
80	85
90	85
95	85

The figure below shows the change of "Orientation" with Communication.

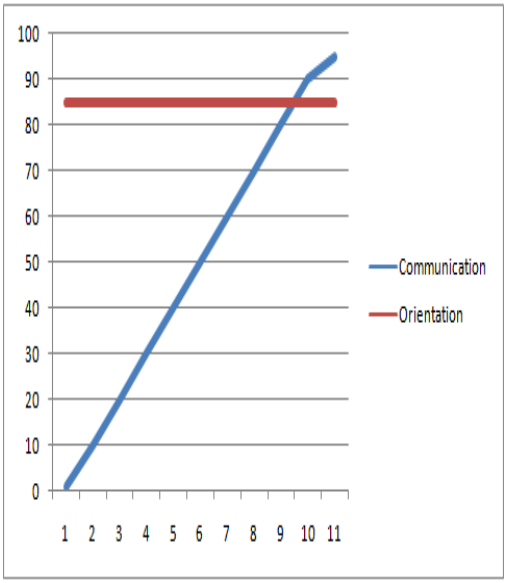

Figure 20: the change of "Orientation" with Communication.

Discuss the curve of the example N°6:

The value of the orientation remains fixed at value 85, despite the fact that the parameter: Communication
increases linearly.

4.3 The contribution and limitations of our piece of work

The fuzzy logic approach allowed us to obtain better results in our study: Decision-makers will be able to overcome the difficulty regarding ambiguity and uncertainty in decision-making regarding the orientation of students after the baccalaureate thanks to fuzzy logic.

Fuzzy logic is easy to use and thanks to the 3D simulations obtained by Matlab(in figure 10, 12, 14) , the decision-maker can make the decision concerning the orientation of the student according to the situation he is facing, roughly when we fix in advance a single criterion, or when two criteria are fixed in advance.

Contribution at the individual, societal and scientific level:

At the level of society: The time spent at the university is an important period for the student and when he is he is well directed and oriented towards a good choice then there, he will excel in terms of his competence and his production at the level of the company where he will work so it will be a gain for his family, his company and his society.

At the scientific level, this is the first time in Morocco, and in the education sector that the

fuzzy logic method has been applied to aid decision-making in order to better guide students before they go to university in the education sector which is really a great scientific added value for this sector.

They are also a lot of goals achieved:

- ✓ Effectiveness of the method: The fuzzy logic approach employed in decision making regarding student orientation has results which overlap more with the actual results, which proves the relevance of the method employed. . This method of decision support is simple to use and reflects reality and it is not specified for a single manager or decision maker in the university or school but intended for all managers, without exception.
- ✓ The extension of the method to aid in decision-making in guidance for the different levels of education not only for students who are going to study at university but also for students who will be oriented before they enter high school.
- ✓ The right choice when orienting the student has an impact on the development of society and the development of the country, because a well-oriented student has a good chance of being a productive citizen for his country.
- ✓ Since we are in the perspective of improving the three criteria at the same time for the good of the orientation of the student, we must imperatively improve the motivation of the student by bringing a specialized person such as a coach to help the student. student to be highly motivated. Regarding student grades we will need to send emails to interested students before they take the baccalaureate exam so that they are informed that the best students with good grades are likely to be well oriented. In addition, we must bring in a professional person specializing in communication who will help the student to improve what he wants to express before taking the orientation test to enter university.

However, research remains limited because it becomes difficult with the increase in the number of criteria or inputs, because each input requires that we enter it in the Matlab software with a membership function and even for this one, it may be that there are not only three variables (Bad, average, good) there may be several variables like (Bad, average, good, excellent ...). Also for increasing the number of rules too (More than 30 rules) it will not be easy to implement and it will be tiring.

Also we only considered the three criteria which are "Grades", "Motivation" and "Communication" in general but we did not consider or mention the sub-criteria of each criterion for this study. Because for a single criterion there may be several sub-criteria, for example for the criterion of "Grades" we can consider the sub-criteria as grades of mathematics, grades of physics, grades of philosophy ... For each sub-criterion we must consider its fuzzification and the rules between the sub-criteria and their defuzzification.

In comparison with a research carried out in 2017 in the same education sector which is called: Student performance evaluation model based on scoring rubric tool for network analysis subject using fuzzy logic carried out by Deshmukh et al. [40] , while our research carried out was aimed at applying fuzzy logic for a good orientation for the student.

We can list the difference between these two searches as follows:

- ✓ In this research paper that we carried out we had three criteria which are: motivation, communication and grades while for the research of Deshmukh et al.[40] there were five criteria which are: Identify, Understand , Apply, Calculate, Create.
- ✓ For the membership functions we had for our research 3 membership functions (bad, average, good), while for the search for Deshmukh et al. [40] there were five membership functions which are Unsatisfactory, satisfactory, Good, Very good, Excellent
- ✓ There was also a difference regarding the number of rules, in our research we had 27 rules while for Deshmukh et al.[40] there were only 18 rules.
- ✓ For the output which is the orientation there were three types of linguistic expression which are: Bad, average, good, while for the research of Deshmukh et al.[40] there were five linguistic expressions which are: Very poor, average, good, very good and excellent.
- ✓ Regarding the achievement of the objectives, the two studies achieved their desired objective, whether for the research of Deshmukh et al.[40] which was able to determine a decision support system concerning the performance of the student for the desired subject, while for our research we

were able to provide a decision support system concerning the orientation of the student before he before he goes to university.

- ✓ In terms of the difference in results between our search and the search performed by Deshmukh et al.[40], this is due to the way in which the fuzzy logic method was applied according to which criteria, with which rules, and their numbers, as well as the nature of the output.

Many research questions can be opened as a result of this research such as: can we consider other criteria other than motivation, communication and grades, and expand our study?

Considering our case, we were based only on these three criteria, but for example for another university or another case, it is possible that the decision maker indicates that there are other criteria, sometimes more than 10. To have better results, we need to do a study or a comparison between the applications of two combined methods like for example fuzzy-Topsis compared to fuzzy-Entropy. We use the methods like Topsis, Entropy in order to weight the most important criteria following a decision matrix and we limit to 5 criteria or 4 criteria for example, instead of 10. Then we use the fuzzy logic method to develop a decision support system.

5. CONCLUSION

Our main objective in this research that we conducted is the application of the approach: Fuzzy-logic for determination of the best orientation in an engineer school with the intention of treating the problem of uncertainty in human decision making.

First, after presenting the importance of education, we determine the three input variables that are the criteria: “Communication”, “Motivation” and “Grades” and the output variable which is only the Orientation. Then, we determine for the four parameters: inputs and output, the range and the membership function in the fuzzification phase.

Secondly, we do fuzzification: We model the criteria chosen by membership function after determining the linguistic values of each criteria. Furthermore, we construct fuzzy-rule and for decision making and we apply defuzzification : the fuzzy values is converted to crisp value.

Thirdly, in the section: Discussion, we present the effectiveness of the application of Fuzzy-logic method for the case studied through this piece of research and some limits. In this study that we carried out, we developed simulations in 3 dimensions and in 2 dimensions, we interpreted these graphs from the data that we have, for example for the case where we have fixed a single criterion which is the communication we had a graph presented in figure 12 which indicates the orientation is Good, it is when the two other criteria which are the motivation and the grades are better. In the same way, we have done this for figures 13 and 14. Regarding, for example the interpretation in 2 dimension, for figure 18 for example, we fixed two criteria which are motivation and communication at 80 in advance and we had the change of the third criterion (not fixed) who is "Grades" with the output or orientation, and that the latter has a positive impact (it is increasing) with the change of the "Grades" criterion. In the same way we proceed for figures 19 and 20.

In the same education sector, we compared our research with research carried out by Deshmukh et al.[40]: The fuzzy logic method was applied in order to help decision-making regarding performance students or final score based on 5 criteria and 18 fuzzy rules, while for our research we are based on three criteria which are and on the orientation of the student before entering the university.

Finally, this proves that fuzzy logic is easy and very simple to use. Fuzzy logic has allowed us to deal with the problem of uncertainty and ambiguity which is present in the decision-makers of university. This approach has allowed us to meet the goals of student orientation that has results that translate into reality. We can extend the application of this approach to all levels without exception. We can also add some other criteria in a search and compare it with this one.

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