

Article

Analysis of the Potential Factors Affecting the Higher Education Quality using Soft Computing Technique

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ABSTRACT: With society's continual technological improvements and modernity, it is critical to stay up with the advancements in instructional tools. To address this, a comprehensive study was done to investigate the elements influencing the quality of higher education in accordance with contemporary educational systems. The study sought to uncover the precise elements that have a major influence on the progress and improvement of higher education. Soft computing approaches, such as fuzzy logic, were used to anticipate the influence of numerous criteria on higher education quality, such as teacher-to-student ratio, classroom atmosphere, learning materials, current tools, managerial efforts, and academic assistance. Changes in these elements can improve students' thinking and talents, resulting in a better society with more economic power. This work uses the fuzzy logic system in order to find that by enhancing these elements, educational quality may be improved, resulting in high-quality instruction and a better society.

Keywords: Fuzzy Analysis; Decision Making; Education; Parametric Analysis

Introduction:

Higher education is critical to a country's economic and social growth. The quality of higher education is a crucial factor of a country's workforce and economy's competitiveness [1, 2]. Excellent education may boost human capital, innovation, and production while also preparing people to adapt to new conditions at work and in their personal life [3]. In recent years, there have been major changes in higher education in terms of student enrolment, curriculum, and teaching techniques [4, 5]. The ultimate purpose of higher education, however, remains the same: to provide a quality education that prepares students for the job and assists them in achieving their professional and personal objectives. The quality of higher education is determined by a variety of variables, both internal and external. These factors include Good teaching methods which can improve higher education quality by increasing student involvement and learning experience. Project-based learning, experiential learning, and flipped classrooms are some examples of excellent teaching strategies. Similarly, modern facilities, such as libraries, computer laboratories, and science labs, may considerably improve educational quality [6-8]. Skilled and experienced professors can provide students with a great education and motivate them to thrive in their professions. Inexperienced or underqualified professors, on the other hand, might have a detrimental influence on educational quality [9, 10]. Quality education is regarded to be provided by institutions that create graduates with strong employability and research capabilities [11-13].

As the environment of higher education has changed, quality teaching has become increasingly important. Students have grown in number and diversity, both socially and geographically [14-16]. New pupils necessitate fresh teaching strategies. Modern

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technology have penetrated the classroom, altering the character of student-professor relations [13, 17, 18]. Aspects influencing educational quality assurance include adequate monitoring, student and faculty staff, institutional mechanisms, and available programmes and other factors as shown in figure 1. Memon et.al, predicted that the higher education trends depends on the characteristic and motivation of student to opt and analyze the course [19]. Dinther et, al. add that the impact of better higher educational program alongside systematic and effective learning may raise students' self-efficacy as well as provide better educational outcomes[20]. Wang et.al, provides that idea that the scientific, reasonable, and practical evaluation methods for teaching effect, reflecting the teaching requirements, policies, faculty, and capital investment are the main sources to improve the overall efficiency of the higher education system [21]. However, it is required to address and predict the impact of varies different types of educational parameters on higher education. This is due to the fact that it will enhance the thinking and capabilities of students, quality of education will improve and a better society with great economic power can be created. Way to predict the parameters includes various different computing techniques like expert system, machine learning, artificial intelligence and fuzzy logic system.



Figure 1: Factor affecting the Quality assurance in Higher Education

In this work, the prediction of the impact of various parameters on the quality of higher education is carried out using fuzzy logic system. This includes the impact of teacher to student ratio, classroom environment, learning resources, modern tools, management efforts and academic support on the higher education. Fuzzy logic system is used in order to predict the impact of the parameter due to its better accuracy and higher closeness to human thinking.

Fuzzy Analysis

MATLAB fuzzy rule based system is used in order to predict the impact of various parameters on higher education. Fuzzy analysis to predict the impact of teacher to student

ratio, classroom environment, learning resources, modern tools, management efforts and academic support on the higher education taken.

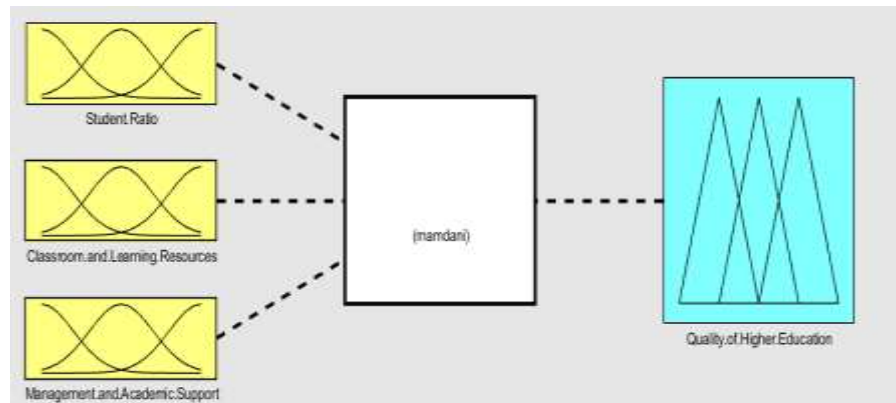


Figure 2: FIS figure of the parameters and its impact on the higher education

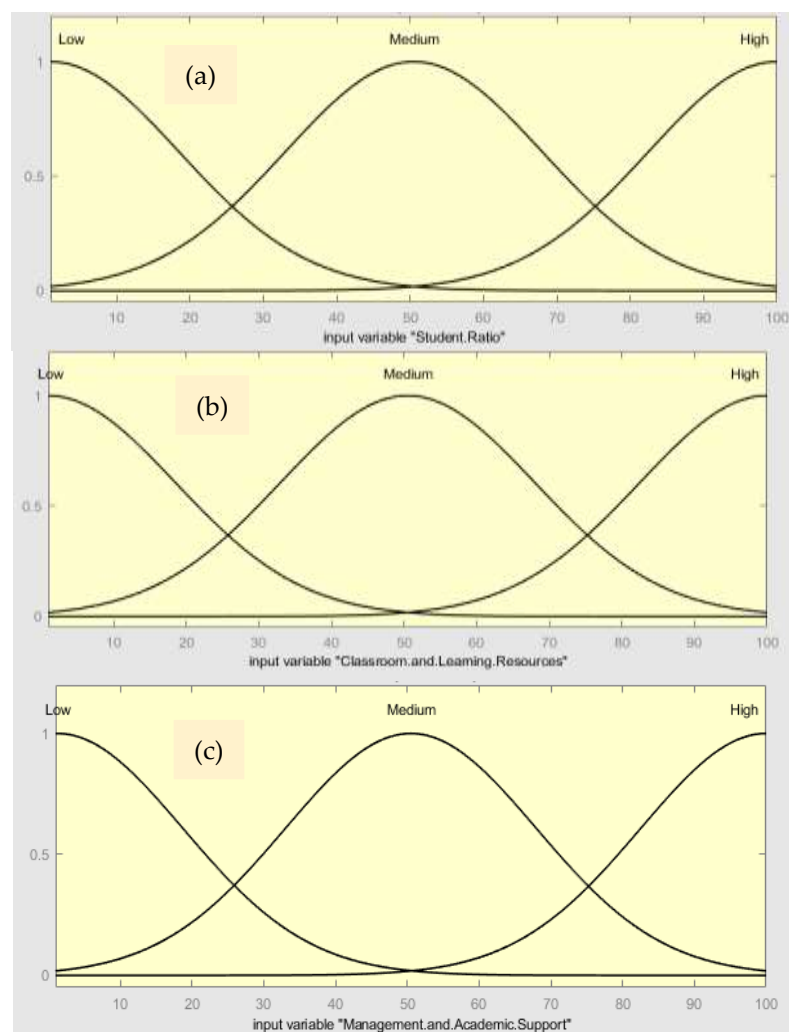


Figure 3: Membership functions and ranges for input (A) Student Ratio (b) Classroom and Learning Resources (c) Management and Academic Support

Figure 2 shows the FIS figure of the impact parameters and its impact on the output parameters. After the FIS, Membership function editor is used where the ranges and the membership function are set. The ranges and membership functions for the input are shown in figure 3. The range for membership function student ratio is taken as 1-100% with membership function low, medium and high as shown in figure 3(a). The range for membership function class room and learning resources is taken as 1-100% with membership function low, medium and high as shown in figure 3(b). The range for the membership function is taken as 0-50 for low, 0-100 for medium and 50-100 for high. The overlapping between membership functions is taken because of the use of MAMDANI model for simulation.

The range for membership function management and academic support is taken as 1-100% with membership function low, medium and high as shown in figure 3(c). The output membership function and ranges are shown in figure 4. The range for the output quality of education is taken as 0-100% with the membership function as low, medium and high. The membership function range are taken similar to the input in order to generate graphs in the non-linear regions.

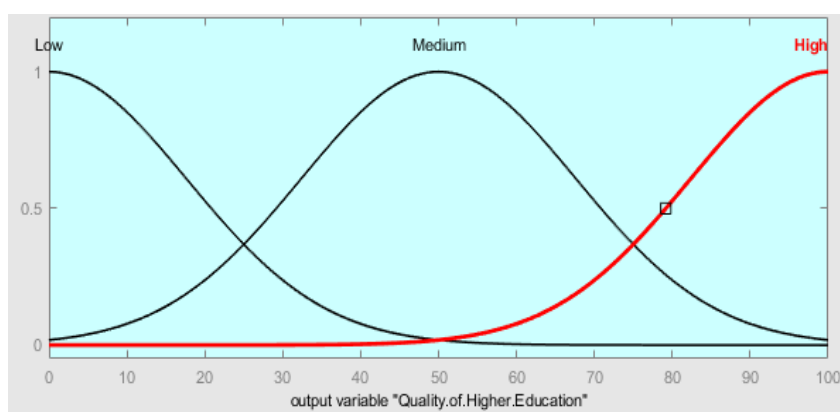


Figure 4: Membership functions and ranges for output quality of higher education

The rules are then defined based on real life scenarios, experts and literature. The number of rules depends on the number of inputs and the associated membership functions. The number of rules are defined as m^n where m is the number of membership functions and n is the number of input defined. For this work, the number of rules defined are 27.

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Results and Discussion

Based on the rules defined, the 2D and 3D graphs for the work are defined. The 2D graph between student ratio and the quality of education is shown in figure 5. The graph shows that Better the Student Ratio with respect to the teaching staff a slight improvement in the Education quality is observed. It predict that the task-focused, disciplined, and engaged the teaching staff is, better would be the student knowledge outcomes.

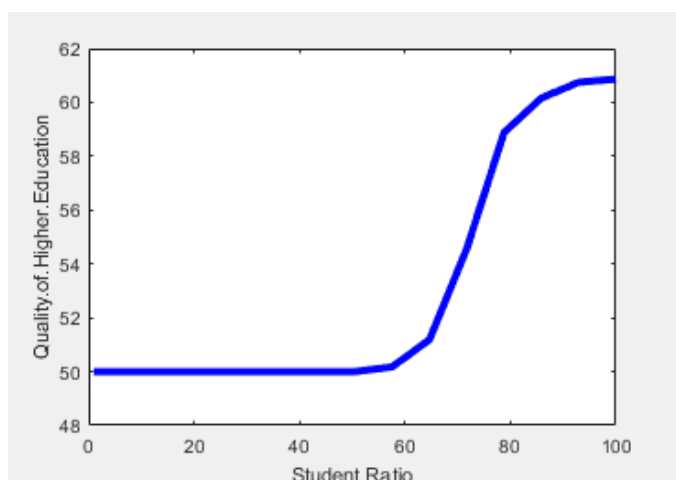


Figure 5: 2D graphs of Student Ratio with Quality of Higher Education

Figure 6 shows the 2D graph between classroom and learning resources with respect to the quality of higher education. Better Classroom environment results in higher education quality. Learning Resources aligned with the technological changes provide better and enhance learning outcomes.

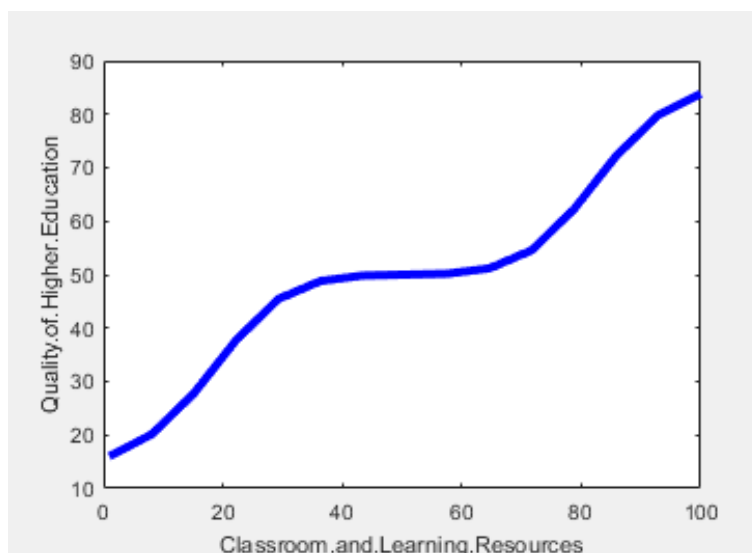


Figure 6: 2D graphs of Classroom and Learning Resources with Quality of Higher Education

Figure 7 shows the 2D graph between management and academic support with respect to the quality of higher education. Higher quality of education with better management and academic support can be achieved based on the fact that the it will provide better understanding and course analysis with more understanding of the technological trends

for better higher educational research. Management and academic support are critical for preserving higher education excellence. Management develops rules and processes to guarantee successful resource management, whereas academic support services assist students in overcoming obstacles and developing critical abilities. Both contribute to the development of a welcoming and inclusive atmosphere for students and teachers.

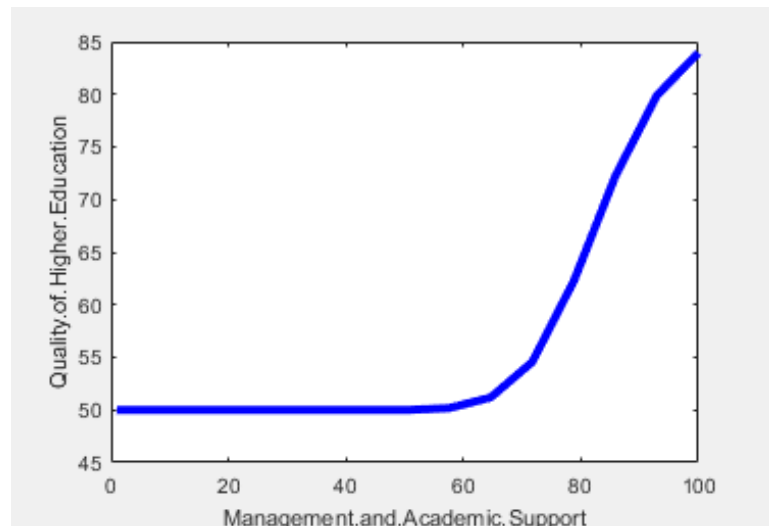


Figure 7: 2D graphs of Management and Academic Support with Quality of Higher Education

The 3D graphs between the input and output is shown in figure 8. Figure 8 (a) shows the 3D graphs between Student Ratio and Classroom and Learning Resources with quality of Higher Education. Figure 8 (b) shows the 3D graphs between Student Ratio and management and academic support with quality of Higher Education.

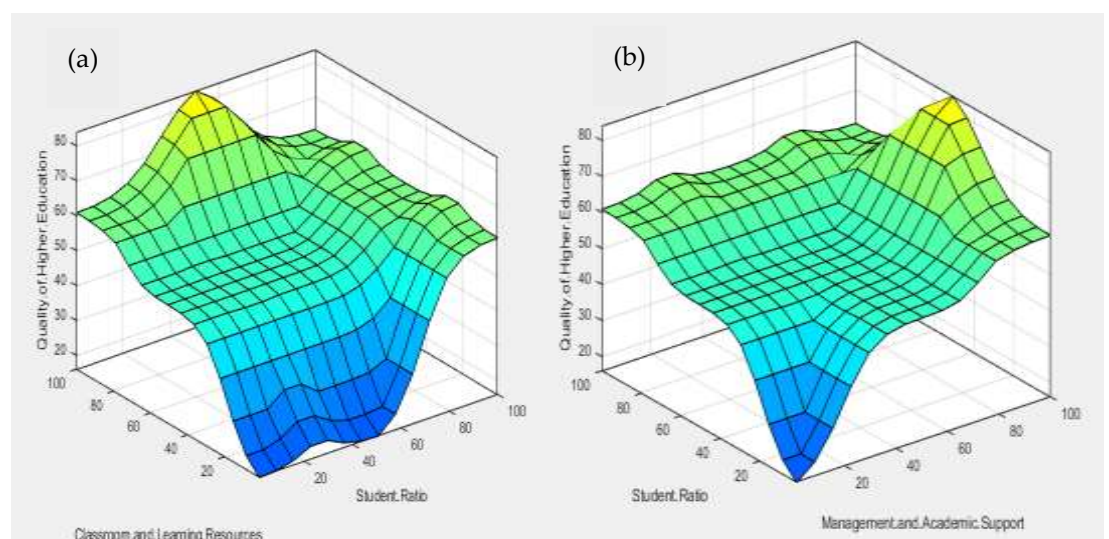


Figure 8: 3D graph between output quality of higher education with input (a) Student ratio and classroom and learning resources (b) Student ratio and management and academic support

Rule viewer for the simulation are shown in figure 9. The simulated output values from the rule viewer is then compared to the calculated values of the output. The comparison of simulated and calculated values is critical in fuzzy rule-based systems since it allows the system's performance to be evaluated and validated. From the crisp values of the rule viewer and the MAMDANI model formula shown in equation (1), the calculated values of the output is calculated.

$$\mathbf{P} = [\Sigma (\mathbf{Ri} \times \mathbf{Si}) / \Sigma \mathbf{Ri}] \quad (1)$$

Where, M_i is the minimum membership function values calculated using the input crisp values from the rule viewer and S_i is the singleton value of the output membership function. The simulate output from the rule viewer is 62% and the calculated output value is 62.05%. Table 1 shows the comparison and the error between the calculated and simulated value.

The minimum membership function value for the calculations are as below,

$$K1 = \text{Maximum value of student ratio} - \text{Crisp value of the student ratio} / \text{Maximum value of student ratio}$$

$$K1 = 0.9177$$

$$K2 = 1 - K1$$

$$K2 = 0.0823$$

$$K3 = \text{Maximum value of classroom and learning resources} - \text{Crisp value of the classroom and learning resources} / \text{Maximum value of classroom and learning resources}$$

$$K3 = 0.187$$

$$K4 = 1 - K3$$

$$K4 = 0.813$$

Based on these values a comparison is created which compare the minimum values for the calculated membership function values. The minimum value is the multiplied with the singleton value to calculate the value of the respective output.

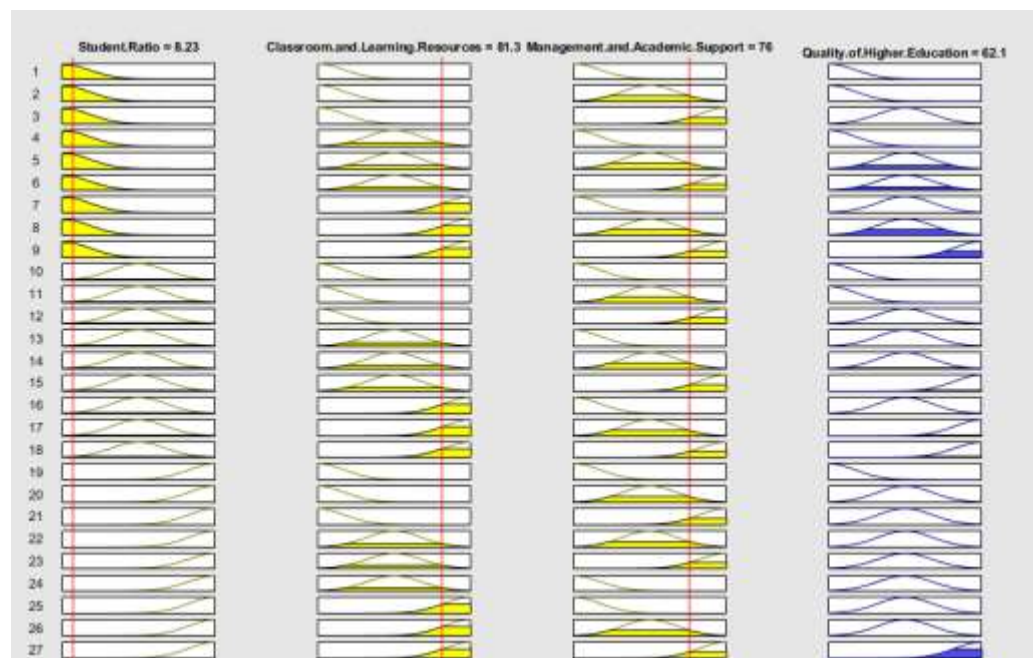


Figure 9: Rule viewer of the simulation work

Table 1: Comparison between the calculated and simulated value of the quality of higher education

	Simulated Value	Calculated Value	Difference
Quality of Higher Education	62%	62.05%	0.05%

The error of less than 1% shows the accuracy of the work. The work shows that the better the input parameters of the factors influencing the higher education, the better is the quality of higher education. This shows that it is required to improve and work on the factors in order to improve the quality within the higher education domain.

Fig. 2 : Frequency with drug

Conclusion

In this work, the prediction of the factor which contribute to the change in the quality of the education in higher education domain is carried out using soft computing techniques. The impact of Student ratio, classroom environment, learning resources, management efforts and academic support on the higher education has been analyzed and found to be the factors that influence the higher education quality. The work shows that the better the factors, the better will be the higher education. Fuzzy rule based system is used which provides a better co-relation between the factors and the quality of the education. Aligning the parameters together will create a better higher education system.

Author's Contribution: I.J.K., M.A., Conceived the idea; I.J.K., & F.Q., Designed the simulated work and F.Q., M.A. did the acquisition of data; M.A., F.A. & I.J.K., Executed simulated work, data analysis or analysis and interpretation of data and wrote the basic draft; F.Q., Did the language and grammatical edits and Critical revision.

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