Model to Evaluate Education System in India using Fuzzy Logic

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ABSTRACT

The Ministry of Human Resource of India, University Grants Commission and other stake holders are working together to ensure quality education to the coming generations. They have recommended certain parameters for the appointment and promotion of the teachers in the colleges and the universities so that the quality of teachers can be enhanced. In this research, a model based on fuzzy logic is proposed that will not only take into account the parameters suggested by the statuary bodies to evaluate academicians but also consider the parameters from the students' perspective like subject knowledge, knowledge delivery, patience etc. Similarly, this research will also focus on the basic qualities of a student and evaluate the student on the basis of the exams based on university curriculum and on the basis of his/her overall development. The parameters like creativity, confidence, and discipline etc. constitute the overall development of a student.

Keywords: Fuzzy Logic, Academician Evaluation, Student Evaluation.

1. Introduction

In today's scenario, the education system has become commercial in India. The higher education institutions are now the source of income to the education societies. It has become the business for many. Lot of engineering, medical and even universities is mushrooming up every year. The cost of establishing the institutions is quite high and to maintain it, is also a herculean task. Also there is a huge dearth of properly qualified and experienced teachers particularly in rural India. In order to maintain and to reap high profits, the fee structure is quite high in these institutions. The proposed fee structure in IITs this year (2012-13) is Rs. 200000 per annum. Cost is one aspect, another aspect is the globalization. Now students can go anywhere in the world and do the job of their choice. It is very challenging for the Indian students to compete international students, especially from the developed countries. So, it has become the need of the hour to provide quality education in India. In order to improve the education system in India, it is essential to understand the quality of teachers and the students of the country. Once the quality of students and the teachers is known, it can be enhanced by improving the weaknesses. There has been a debate over teaching skills and teacher experience since the inception of the education system. It is essential in the eyes of educators and students as well to determine what makes a good teacher, and how to improve teaching techniques. Academicians are the Nation Builders. Their job is not only to make the students proficient in the subject but also to make the students a good human being. He/she is actually responsible for the overall development of the students.

In monetary terms, the cost of higher education is whopping in India. At present the minimum payment that an incumbent lecturer receives for imparting one hour lecture to 20 students is approximately Rs. 1535 (Basic Pay 15600+6000 + HRA =20% of Basic Pay + DA 90% of Basic Pay + 500 Medical + EPF 10% of Basic Pay, according to the recommendations of the sixth pay commission), assuming 125 teaching days and 3hrs teaching per day. So, every student has to pay minimum of Rs. 77 for one hour lecture. In order to improve the quality of teachers, it is mandatory for him/her and the other stake holders, to know where he/she is lacking.

Similarly, today's student is the future of a country. It is imperative for the teachers and the parents to understand their psychology. It will help in determining the taste and passion of the youth and making them successful in their future. The problem of the student's evaluation has always been a question of major concern in academic institution due to its inherent difficulties. These difficulties are associated to the understanding of the student's learning process. Learning is a mental process of change and its assessment is known as evaluation. Learning is not just confined to the cramming of prescribed syllabus of the university; it incorporates creativity, self-motivation, intelligence, discipline, confidence, etc.

The National Assessment and Accreditation Council (NAAC) [16] is an autonomous body established by the University Grants Commission (UGC) [17] of India to assess and accredit institutions of higher education in the country. The major constituents of this accreditation are teachers and the students. In this proposed research, focus will be on these two components and help the institutions in improving the level of higher education in India.

2. Related Work

In this section, we review the previous works that are related to the evaluation of teachers and students based on soft-computing techniques. [1] Proposes a methodology using fuzzy logic to measure the quality of education by using quantitative and qualitative values with the hopes to develop criteria for the quality of education in a way closer to the realities of Latin American countries. The quality of education is measured using the parameters like the ratio of students per teacher numbers, the access that students have to technology and by appropriately spending their budget they are able to allocate to the authorities of various countries or the percentage of Gross Domestic Product (GDP) spent on education. [2,4] Reviews the various strands of research related to teacher quality including: the role of aggregate salaries, the supply of teachers with different characteristics, the relationship between teacher characteristics and student achievement, and direct estimates of the value-added of teachers. It also proposes that in order to improve the quality of teachers, their salaries and incentives play a major role. It has considered more parameters like teacher experience, teacher education and teacher test scores for evaluating teacher quality. This paper is concerned with the supply and selection of a quality teacher not with the evaluation of the currently employed teacher. [3] Reviews the literature and finds that the quality of teachers varies considerably in the initial years of the service but doesn't improve over the course of a teacher's career. This is because there are no set criteria for evaluating the quality of teacher. [5] Studies the effects of various types of education and training on the ability of teachers to promote student achievement are studied .The results suggest that only two of the forms of teacher training influence productivity. First content-focused teacher professional development is positively associated with productivity and the second, more experienced teachers appear more effective in teaching. They also show that there is no evidence that either pre-service (undergraduate) training or the scholastic aptitude of teachers influences their ability to increase student achievement. [6] Looks the way in which student's evaluates their teachers on certain behaviors that have been shown to result in better teaching methods. The study also looks at the way in which these evaluations are affected by the amount of experience a teacher has had. The results of the student surveys are compiled into the experienced and less experienced and then analyzed using a t- test to see if ratings of the teachers are indeed affected by the teacher's level of experience. The researcher's observations are also compiled in two groups of experienced and inexperienced. A t- test was used to see if there is a difference in teaching behaviors between experienced and less experienced teachers. [7] According to this research, Teachers do not enter the classroom as finished products. They improve with the passage of time. In this paper, they develop Educational Testing Services (ETS) that work with policy-makers and practitioners to improve teacher quality and student achievement. From their perspective, strong subject knowledge and knowledge delivery are both essential qualifications that beginning teachers must possess. It also urges all states to establish induction programs for beginning teachers, providing mentoring and support during the first years of teaching. They have put more emphasis on observing and evaluating teachers' teaching skills and content knowledge in their actual classrooms throughout their careers. [8] Proposed a Fuzzy Expert System (FES) for student academic performance evaluation based on fuzzy logic techniques. It introduces the principles behind fuzzy logic and illustrates how these principles could be applied by educators to evaluating student academic performance. The results are evaluated from fuzzy expert system, a difference in outcomes is seen between the classical mathematical model and proposed fuzzy logic based expert systems methods and found that fuzzy logic has greater flexibility and reliability. [9] Proposed a method called Student Idol to evaluate student through three categories which are academic, co-curriculum and leadership. Teacher can easily evaluate their student without having any emotion factor, relation factor and others. They found that this method of evaluation of students is better than the conventional system. [10] Develops a web-based information system has been implemented for engineering education. With the help of this system, they can have a comprehensive student performance evaluation based on the engagements in the laboratory activities. It only considers the practical exposure of the student in the subject concerned. [11] Demonstrates fuzzy logic based evaluation technique for accessing the student's performance. They have assigned fuzzy lingual variables to each question pertaining to its importance, complexity and difficulty by using fuzzy membership functions. Then they have evaluated a score depending on the membership degree of uncertainty factors in each question. In addition, they considered the time consuming element for solving a question. They used inverse sigmoid function to consider time consuming element, fuzzy concentration and dilation function for importance, a sigmoid function for complexity, and fuzzy square method for difficulty. The shortcoming of this research is that, it heavily depends on the student's response time. [12] Proposes two new methods for evaluating students' answer scripts using fuzzy sets. The proposed methods can overcome the drawbacks in [13] as they do not need to perform the complicated matching operations and can evaluate students' answer scripts in a fairer manner. In this paper eleven satisfaction levels to evaluate students answer scripts regarding a question of a test/examination were proposed such as:- Extremely Good (EG), Very Very Good (VVG), Very Good (VG), Good (G), More or Less Good (MG), Fair (F), More or Less Bad (MB), Bad (B), Very Bad(VB), Very Very Bad(VVB) and Extremely Bad (EB).

Though lot of work has been done both on the evaluation of teachers and students internationally but it did not focus on the factors like adaptive nature of the teacher or discipline of the student etc. These factors play a very

important role in evaluating overall quality of teachers, students and education system as a whole. This type of evaluation will help in improving student-teacher relationship, which will further improve the confidence both in students and teachers and they can perform better in their future. of the focus more on Indian scenario where approximately half of the population is staying below poverty line and the higher education is very expensive. In India, it is very essential to improve the quality of higher education so that the living standards of the people can be raised.

3. Proposed Cross Fuzzy Model

Till now, there is no systematic approach which can throw light on the deficiency in the teacher's skill set. This study will look at the way in which students evaluate their teachers on certain behaviors. This research will focus on analyzing, interpreting and developing a set of skills that are required to access their quality. This skill set is further used to access the quality of the teacher under consideration using fuzzy technique. Same methodology will be applied in evaluating the quality of the students. First, the factors on which the student will be evaluated will be decided and again fuzzy logic will be applied to evaluate the students. The results obtained will be validated and verified using various statistical techniques. This approach will provide the overall quality of the teacher-student learning process. It will help in improving the quality of academician, students and the education system as a whole. Following algorithm explains the cross fuzzy system to evaluate and interpret the quality of students and teachers.

In this model, the teacher will evaluate the students using the fuzzy model assuming that all the teachers are unbiased. Depending upon the aggregate evaluation by the teachers, the students are ranked. These ranks will be used as the weights while they will evaluate teachers. This model will highlight the deficiencies in the teachers and the students and help them improve.

Algorithm: Cross Fuzzy Model to Evaluate Education System in India: Teacher Student Perspective

1) Read number of students.
2) Read number of teachers.
3) Set sum of student weights as: SET $s_{qw} = 0$ and SET s =1.
4) To evaluate student(s)[calculate total marks and weight]
   Loop 1:
   Check if s<=s_n(total number of students)
   　　　　SET sum = 0 and t = 1
   　Loop2:
   If t<=t_n, then :
   　　　　Input parameters from t^{th} teacher and
   　　　　Set qs[t]=quality of student is a M.F.I.M
   　　　　Set sum= sum+qs[t]
   　　　　t=t+1
   [endif]
   [end loop2]
   [end loop1]
5) Student s is evaluated by all teachers and t<=t_n is false, so
   SET avg = sum/t_n, where avg is arithmetic average of all teacher evaluation's assuming teachers evaluation is unbiased.
   　SET q[s]=overall student quality is a output function of M.I.F.M [good, poor and average]
   SETset q_w[s]= avg [marks become weight of student]
   　SET s_{qw}(sum of weights)=s_{qw}+ qw[s]i.e. add s^{th} student weight to sum of weights.
6) To evaluate teachers by s^{th} student:
   　SET t=1
   　SET sum_t[t]=0, where t is the counter for the teacher and sum_t[] is the array to store t^{th} teacher's final value.
   　Loop3:
   　　　　Check if t<=t_n, if true:input parameters by s^{th} student for t^{th} teacher.
   　　　　SET qw[s]=quality of tth teacher by s^{th} student using M.I.F.M.
   　　　　SET sum_t[t]+=qt[s]*qw[s] i.e., add weighted marks of teacher 't' by student 's' in the sum_t[t] array , which stores total marks of all teachers as a weighted sum of all students.
   　　　　Set t =t+1
   　　　　if s=1:
   　　　　　　　　Set sum_t[t]=0, which initializes next teacher's marks=0.
   　　　　　　　　If s=1 i.e., initializing for the first time student.
   　　　　[endif]
   　[end loop3]
7) Set t=1

Loop4:
  a) Check if $t < t_n$
        Set avg = sum_t[t]s$_{qw}$
        Set q[t]=overall teacher quality(as per M.F.I.M)[avg, good, excellent]
        T=t+1
  [end loop4]
8) Stop.

4. Methodology to Implement Proposed Model

The term "fuzzy logic" [18] emerged in the development of the theory of fuzzy sets [14]. FL is a form of multi-valued logic derived from fuzzy set theory used to deal with reasoning that is approximate rather than precise [19]. FL is a form of artificial intelligence that uses a collection of membership functions [20,21] and fuzzy rules instead of traditional bi-valued logic. During its initial years, FL was primarily used for designing control systems [14]. However, with the development of FL theory, new concepts evolved which can be summarized in the following four steps:

- **Step 1:** Fuzzification defines membership functions for linguistic terms. For instance, we defined extent of knowledge of a teacher into three linguistic terms, namely: average, good, excellent. A detailed description of fuzzification mechanism and definitions of the various types of membership functions can be found in the literature [22,23].

- **Step 2:** Designing the knowledge base by designing the fuzzy rules using an if–then format. These rules are defined using linguistic terms such as: If (knowledge is average) and (k.d is excellent) and (c_skills is good) and (motivator is good) and (punctual is excellent) and (adaptive is good) and (creative is excellent) and (inspirational is excellent) and (conduct is good) then (output1 is good)…..Usually, for each linguistic term, a corresponding fuzzy set can either be designed with the help of expert(s) or derived from existing data to meet the definition of a fuzzy set [24,25].

- **Step 3:** Rule Evaluation (application of fuzzy rules); the scaled input, presented by the student/teacher, will cause various rules to fire with varying strengths. For instance, the extent of knowledge, knowledge delivery and other parameters cause not one but several rules to fire. This leads to decisions regarding the quality of an academician/student. The strengths of the rules are evaluated to reach to the conclusion.

- **Step 4:** Defuzzification (Obtaining the crisp result); finding the crisp outcome for output variables is important in our scenario since the proposed system needs to inform the students, teachers and other stake holders about the quality of an academician and students and the weakness thereof. In this model, we will define an output variable, representing the overall quality of an academician/student.

5. Conclusion and Future Work

In this paper, a fuzzy model is proposed to make the higher education system in India, more effective. The impact of this research on teaching learning process will be as follows:

- The teachers will be evaluated not only on the basis of his personnel achievements but also from the students' point of view. It will help in improving teacher-student relationship.

- This research will help in understanding the deficiency in the teacher concerned and further necessary steps can be taken to improve. This reoccurring process will improve the overall quality of the teacher.

- Good teachers can contribute to the society in a better way. They can do research and develop new theories or products that can be of great use to the society.

- In this research, the student will be evaluated on the basis of the overall development that includes class behavior, discipline, understanding etc and on the basis of the curriculum prescribed by the university. It will help the student to perform well in future.

- This research will be helpful in making the students more acceptable in the industry that will further help in improving the living standards of the people of the country. It means that if the students are paying more for the higher education, they are getting more from it.

- This research not only helps in the placements of the students but also help in making them better citizens socially.

Acknowledgement

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