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Enhancing Quality in Technical Education: A Comprehensive Approach for Stakeholder Collaboration

GURUGUBELLI DIVYA [#1], CH.BHANUSRI [#2]

M.Tech Student [#1] , Assistant Professor [#2]

Department of Mechanical Engineering,

Sanketika Vidya Parishad Engineering College (Autonomous), Madhurawada, Vishakhapatnam.

Abstract:

Education stands as a cornerstone for economic development and self-sustainability, intricately linked to growth and living standards. This holds especially true for Technical Education Systems (TES), where stakeholders—faculty, students, management, and infrastructure—play pivotal roles in ensuring efficient functionality. This study emphasizes the imperative of delivering high-quality technical education at all levels and introduces procedures to assess and enhance its standards. Drawing from extensive research using diverse methodologies, this work is grounded in a thorough literature review. Quality in technical education transcends academic culture, extending to outstanding academic results, adaptive management, clean administration, and the distinguished profiles of outgoing students. Stakeholders, including students, faculty, supporting staff, administrators, parents, government, industry, and society, bring varied expectations and perceptions, interacting with the system uniquely. Classified into input, transformation, and output stakeholders, they collectively contribute to the educational landscape. Students and parents are input stakeholders, faculty serves as transformation stakeholders, while corporations and society represent output stakeholders. The Technical Education System (TES) aims to develop methodologies that not only improve education quality but also establish a novel system tailored to its unique requirements. The study delves into identifying critical factors, fostering collaboration among stakeholders, and ultimately creating a framework that ensures the continual improvement and monitoring of technical education quality.

Keywords: Technical Education Systems, Stakeholders, Expectations, Perceptions, Education Quality.

1. Introduction

High-quality education is an indispensable requirement across all societal strata. Parents are eager to enrol their children in top-tier colleges or institutes to ensure they receive high-quality education at affordable prices. The boards of trustees and management are seeking to recruit dedicated and diligent teaching professionals in order to consistently enhance the quality of education. However, they also desire to reduce the operational costs associated with the institute.The government aims to ensure that public funds allocated to education are utilized judiciously and with maximum efficiency. Indian universities should provide models and guidelines for quality management to human communities in the multidisciplinary and multicultural environment where the primary ideas of knowledge intersect. Therefore, universities must demonstrate through this new curricular reform their commitment to attaining excellence at a higher level.

Technical education is a fundamental component of the higher education system. The objective of the "change" is to empower the University to play a significant role in the advancement of the community by setting new benchmarks of excellence in the social, economic, and technical domains, thereby fostering the development of a Knowledge society. Technical universities should provide the human communities with exemplary models and benchmarks for quality management. Therefore, it is imperative for institutions to demonstrate this by revamping the curriculum with the goal of attaining excellence. Consequently, there is a growing concern among the public regarding the quality of higher education, which is being addressed through global harmonization efforts. As a result, the management of education quality has become a top priority. The overarching objective of the Technical Universities is to consistently enhance the educational and research procedures established within the departments, while also fostering the development of skilled and competitive professionals who can effectively meet the requirements of contemporary society.

The fundamental tenets of this educational policy are as follows:

1. The alignment of the specialized curriculum with global education norms.
2. Ensuring that the range of specialties offered aligns with the needs of the job market and the evolving trends in society's progress. • Enhancing the university's offerings by establishing an effective communication system with students and international partners to facilitate ongoing improvement.
3. The allocation of resources specifically intended for enhancing the quality of educational and research processes.
4. Education relies on various mechanisms. A technical education system (TES) comprises three distinct stages: input, process, and output, all interconnected through a feedback mechanism, forming a closed loop (see figure 1).

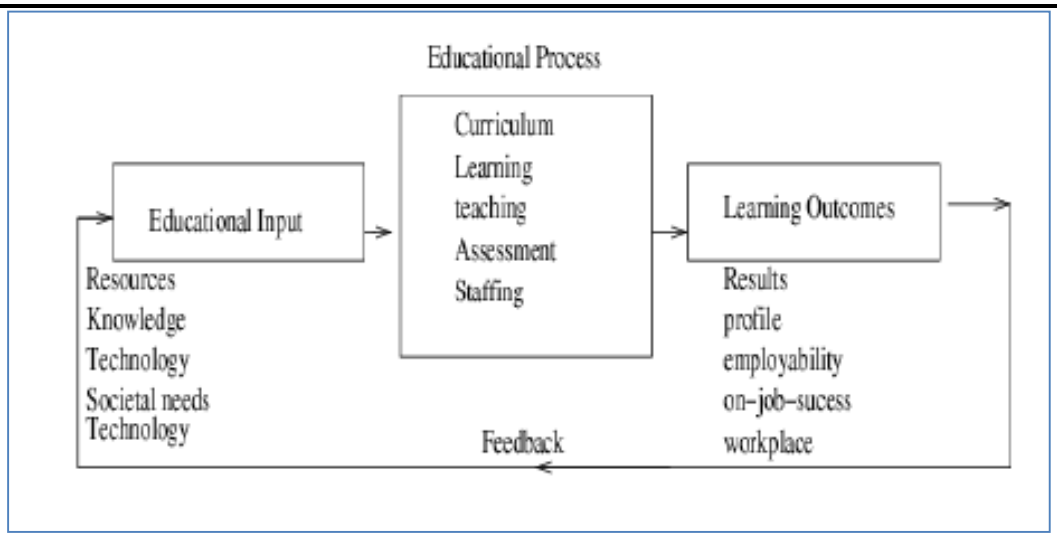


Figure 1. Represent the Block Diagram of Educational Cycle

The primary stakeholders of a TES (Technology-Enhanced System) encompass teachers, students, administration, and infrastructure, all of whom play a crucial role in ensuring the effective operation of the TES.

Service quality can be accessed from three angles: the effectiveness of the product, the conduct of the service provider's staff, and the disposition of the customers. The varied perspective on service quality and its intangible nature necessitates defining service quality as the discrepancy between client expectations (before to service delivery) and perceptions (after service delivery). A positive disparity indicates that expectations exceed performance, meaning that perceived quality falls short of satisfaction, resulting in consumer discontent. Within an organizational framework, a successful quality control program prioritizes the detection of significant disparities in order to minimize them and gain a competitive advantage over rivals. The education sector, specifically the Technical Education System (TES), has a significant impact on society's progress and socio-economic development among all service sectors. An engineer must possess the skill to create systems that meet users' needs through the proper selection, configuration, integration, operation, and control of specific building components. In India, the recognition of this reality occurred at an early stage, prompting the establishment of technical training institutes long ago. Currently, numerous engineering schools and technical universities provide a variety of undergraduate, postgraduate, and research programs. These institutions strive to provide education and also face competition from both domestic and international institutes. The proliferation of private institutions in India can be attributed to the scarcity of state-funded institutions and the reduction in government support for higher education. Consequently, the students have a diverse array of choices when it comes to selecting the institution where they can pursue their interests. Since the students are responsible for covering the entire cost of school, they are entitled to receive the highest quality education. Consequently, institutions now view quality as a strategic advantage in order to effectively serve and attract their main clients, who are the students.

Therefore, it is crucial to create a tool for measuring the quality of education and establish a systematic approach for evaluating this quality. This will provide valuable guidance to the administrators of educational institutions. The quality indicators must meet the expectations of all stakeholders participating in the system. In an educational environment, various individuals and groups, including students, graduates, parents, recruiters, faculty members, support staff, government officials, society, and administrators, engage with the system in different ways and possess distinct expectations. Consequently, the service offerings are likely to vary among stakeholders. The managers of the educational system encounter significant challenges in establishing universally acceptable standards for all parties involved.

2. Literature Survey

Technical education plays a pivotal role in shaping the skills and competencies of individuals, directly impacting the workforce and overall economic development. The following literature survey provides an overview of key studies, frameworks, and insights related to enhancing the quality of technical education through a comprehensive approach to stakeholder collaboration.

Ali, M., & Nekhavhambe, T. J. (2018)[1] proposed a paper on "Quality Assurance in Higher Education: A Literature Review.".This article Explores various quality assurance models in higher education, emphasizing the need for standardized frameworks in technical education.

Akhtar, M. N., & Mishra, P. (2017)[2], proposed an article "Quality Assurance in Technical Education: A Review".In this proposed work the author discusses challenges and prospects in quality assurance specific to technical education.

Freeman, R. E. (2010)[3], proposed an article "Strategic Management: A Stakeholder Approach". In this work the author introduces the concept of stakeholder theory, providing a foundation for understanding the role of stakeholders in organizational success.

Bryson, J. M., & Crosby, B. C. (1992)[4],proposed a work on "Leadership for the Common Good: Tackling Public Problems in a Shared-Power World". In this work the author Explores collaborative leadership models and their applicability to education settings.

Cox, M. D. (2004)[5],proposed a work on "Introduction to Faculty Learning Communities". Here the authors discuss the benefits of faculty learning communities in promoting collaboration among educators for educational enhancement.

Kezar, A. J. (2014)[6], proposed a work on "How Colleges Change: Understanding, Leading, and Enacting Change". In this author explores models of organizational change in higher education institutions, emphasizing the role of collaborative approaches.

Harvey, L., & Green, D. (1993) [7], proposed a work on ”Defining Quality”. Here the authors provide a theoretical framework for defining and assessing quality in higher education, applicable to technical education contexts.

Duderstadt, J. J., & Wulf, W. A. (2002)[8], proposed a work on “Enabling the American Innovation Economy: A Strategic Framework for Education and Technology”. In this current work the authors try to discuss a strategic framework for enhancing education through technology and collaborative efforts.

Mishra, P., & Koehler, M. J. (2006)[9], proposed a work on “Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge”. In this the authors explores the role of technology in education and the need for educators to integrate technology effectively.

Siemens, G., & Tittenberger, P. (2009)[10], proposed a work on “Handbook of Emerging Technologies for Learning”. In this the authors discusses the impact of emerging technologies on education and the potential for collaborative learning environments.

Dhawan, S. (2016) [11], proposed a work on “Industry–Academia Collaboration: A Review”. Here the authors examine the benefits and challenges of collaboration between educational institutions and industries, highlighting its potential impact on the quality of education.

Zhang, Y., & Wildemuth, B. M. (2009)[12], proposed a work on “Qualitative Analysis of Content”. Here the authors provide a methodological guide for analyzing qualitative data, applicable to studies exploring industry-academia collaboration.

Gollner, T. (2018)[13], proposed a work on” Innovation in Higher Education: A Collaborative Case Study”. Here the authors provide a case study on collaborative innovation in higher education, offering insights into effective stakeholder engagement.

Mulder, M. (2016)[14], proposed a work on “Stakeholder Involvement in Education for Sustainable Development: A Case Study”. Here the authors examine a case study on stakeholder involvement in education for sustainable development, providing lessons for collaborative approaches.

Benneworth, P., & Jongbloed, B. (2010)[15], proposed a work on “Who Matters to Universities? A Stakeholder Perspective on Humanities, Arts, and Social Sciences Valorisation”. Here the authors explore stakeholder perspectives on the valorization of humanities, arts, and social sciences in higher education.

Ministry of Human Resource Development, Government of India. (2016)[16], proposed a work on ”National Institutional Ranking Framework (NIRF)”. Here the authors discusses the Indian government's initiative to rank educational institutions based on various parameters, highlighting the importance of quality assessment.

Boud, D., & Middleton, H. (2003)[17], proposed a work on "Learning from Others at Work: Communities of Practice and Informal Learning". Here the authors discusses the concept of communities of practice in fostering continuous learning and improvement in professional settings.

Fullan, M., & Hargreaves, A. (2012)[18],proposed a work on " Professional Capital: Transforming Teaching in Every School ". Here the authors explores the role of professional capital in transforming teaching and fostering continuous improvement in education.

3. Role of Examination System in Technical Education

1. A strict and flawless examination system in an institution or university screens out good students who have attained requisite standards of learning from the rest.

2. In addition, it automatically creates a pressure on other subsystems and processes of technical education, i.e., teaching, infrastructure development, faulty performance improvement, and process of admission in case of high failure rates of the students.

3. It is similar to a quality control (QC) department whose main function is to collect samples of manufactured units as per pre decided sampling plan and to measure various characteristics and attributes of the items for comparing them with the established standards. Products meeting the prescribed standards are certified as FIT and sent to market as finished products while those not meeting the standards are classified as DEFECTIVES which are sent back to production department for repair and rework. After rework, these items are again sent to QC department for certification.

4. The QC department also analyses the root cause for the production of DEFECTIVES and recommends corrective actions for improvement in material quality and process quality. Similar is the function of Examination System in the field of Education.

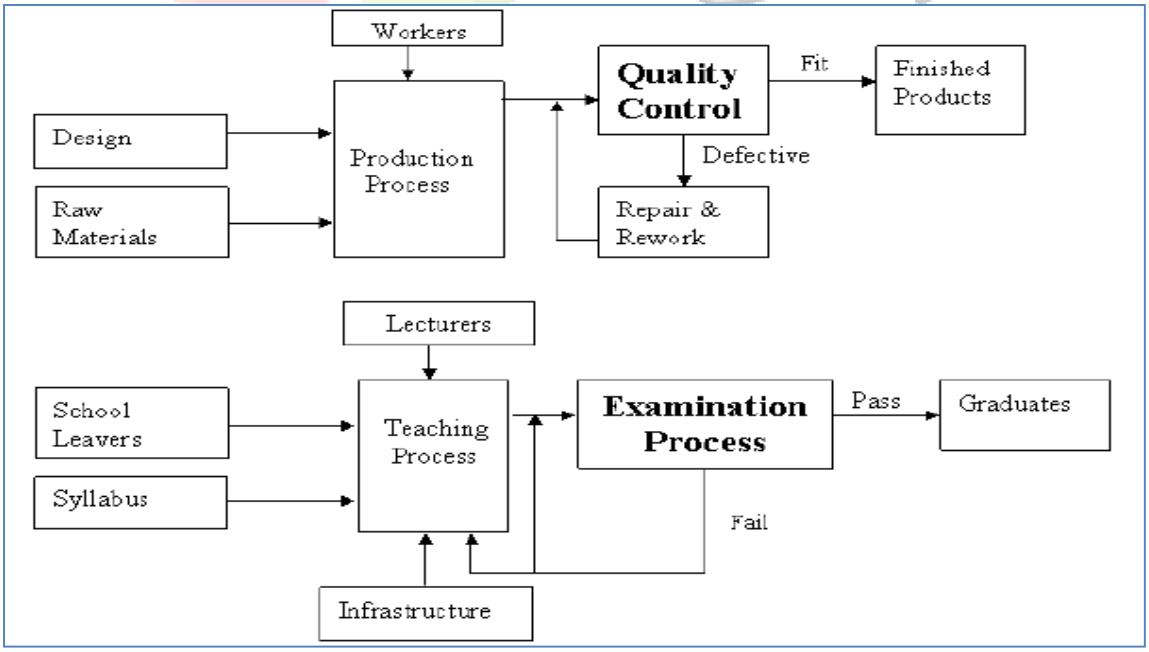


Figure 2. Represent the Role of Examination System in Technical Education

There are several agencies and magazines that undertake the task of ranking academic institutions Country-wise, region-wise and globally. Most of these published rankings indicate the criteria employed; they assign weighting factors to the different criteria and come up with a single composite numerical score. Some of these criteria are:

- Depth and nature of coursework
- Student/faculty ratio
- Selectivity or acceptance rate: number of applications per seat
- Number of enrolled students who graduate (`retention')
- Students' later achievements
- Library facilities
- Laboratory facilities
- Computing facilities
- Reputation/prestige
- Quality of faculty members
- Performance in competitive exams (GATE, CAT, GRE, GMAT, etc.)
- Accomplishments of alumni
- Endowments
- Institutional resources
- Perception of employers
- Productivity research, consultancy.

4. Proposed Research Methodology

In this section we are going to discuss about the proposed research methodology which is used in this proposed work.

Quality assurance in technical or higher education has been a significant concern for several decades. Extensive research has been conducted in the service industries for many years, employing various approaches and methods to reach certain outcomes. However, there has been a lack of research efforts aimed at enhancing the quality of technical education.The approaches employed include Artificial Neural Network (ANN) (35), (116), (120), Fuzzy Logic (41), (112), Analytical Hierarchy Process (AHP) (44), Statistical Process Control (SPC) (117), and Interpretive Structural Modeling (ISM).The aforementioned strategies are employed with great efficacy and have also demonstrated commendable outcomes.We have employed diverse techniques to enhance and evaluate the caliber of technical education in this study. Below, the techniques have been thoroughly explored.

Artificial Neural Network:

Inspired by the structure of the brain, a neural network consists of a set of highly interconnected entities, called Processing Elements (PE) or units. Each unit is designed to mimic its biological counterpart, the neuron. Each accepts a weighted set of inputs and responds with an output. Neural networks address problems that are often difficult for traditional computers to solve, such as speech and pattern recognition, weather forecasts, sales forecasts, scheduling of buses, power loading forecasts, early cancer detection, etc. A neural network is a more general method of regression analysis. Some of the advantages of the network over conventional regression include the following:

1) There is no need to specify a function to which the data are to be fitted. The function is an outcome of the process of creating a network.

2) The network is able to capture almost arbitrarily nonlinear relationships.

3) With Bayesian methods, it is possible to estimate the uncertainty of extrapolation.

Fuzzy Logic:

Logic started as the study of language in arguments and persuasion, and it may be used to judge the correctness of a chain of reasoning, in a mathematical proof for example. In two valued logic a proposition is either true or false, but not both. The ''truth'' or ''falsity'' which is assigned to a statement is its truth value. In fuzzy logic a proposition may be true or false or have an intermediate truth-value, such as may be true. The sentence the level is high is an example of such a proposition in a fuzzy controller. It may be convenient to restrict the possible truth values to a discrete domain, say (0, .5, and 1) for false, may be true and true in that case we are dealing with multi valued logic. In practice a finer subdivision of the unit interval may be more appropriate.

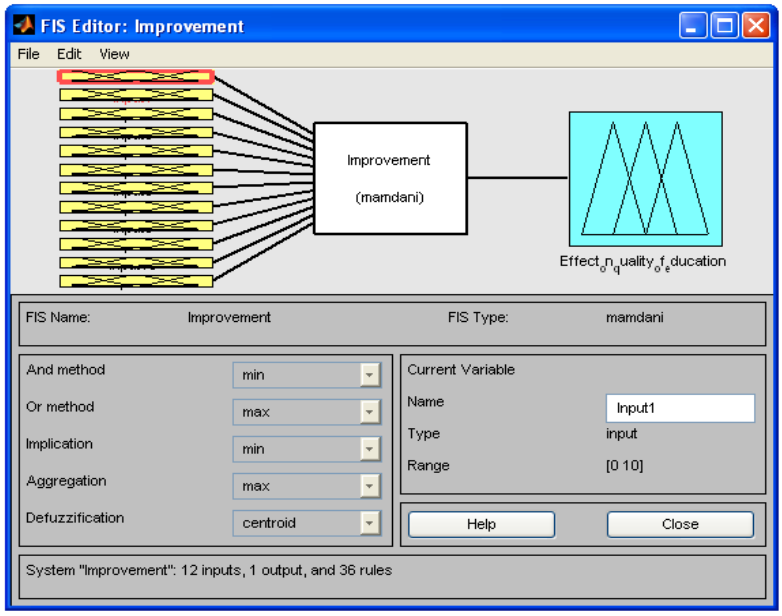
New product (read courses) development (NPD) is closely linked to an institute's competitiveness. Managing NPD is complex and requires consideration of customer (read student) requirements, technical issues, and competing courses and curriculums. The more closely the course fits the students' expectations, the greater the likelihood of successful course and curriculum development. Quality function deployment (QFD) is a well-known tool for identifying customer needs and translating customer requirements into a technical response. QFD translates customer requirements into technical specifications appropriate for each stage of product development and production. QFD considers customer requirements by examining development space as well as product differentiation, position, and characteristics. Moreover, QFD can enable businesses to integrate R&D, manufacturing, and management when drafting a marketing policy. QFD is based on the construction and analysis by the house of quality (HOQ), which documents the transformation of customer needs into technical specifications.

5. Results and Discussions

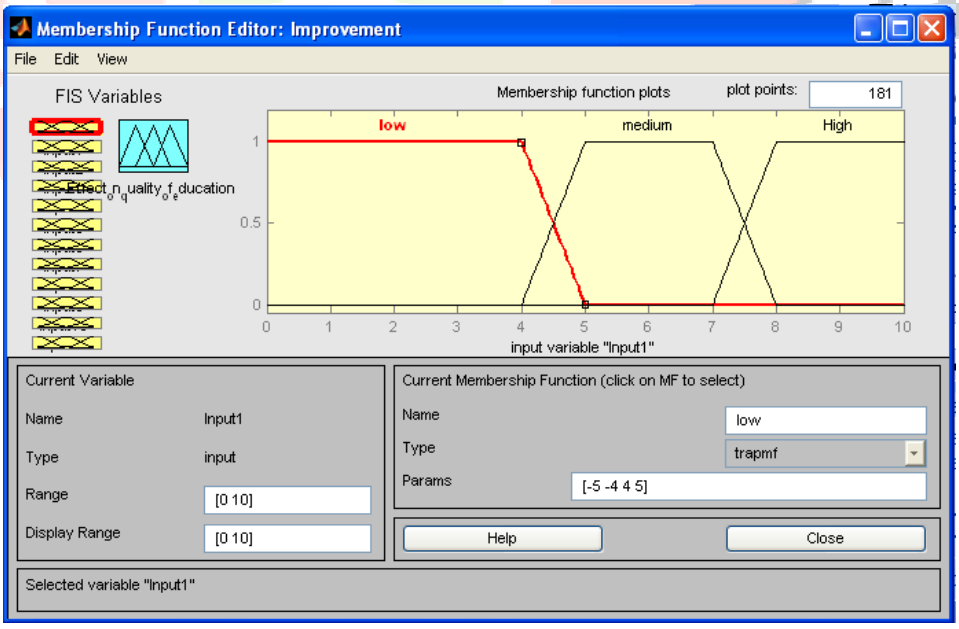
Using Fuzzy Logic Tool Box:

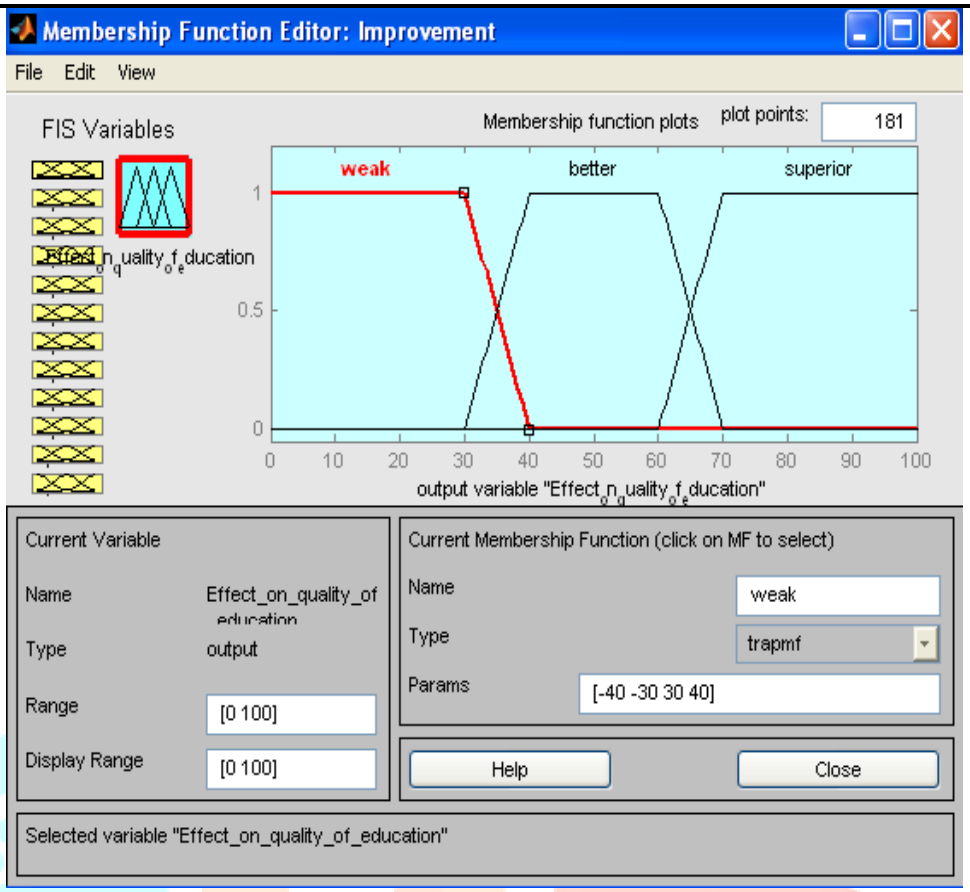
Here the input variables in fuzzy tool box of MATLAB and finding the output i.e. prediction of improvement in quality of education (Fuzzy file =Improvement)

Step 1: Here the various input variables are added as input to FIS EDITOR WINDOW as shown in figure below.



Step 2: For each input factor membership function is added. Here membership function selected is trapmf with range Small, Medium, Large As shown below. For various input (factors) and output (Improvement in Technical education).

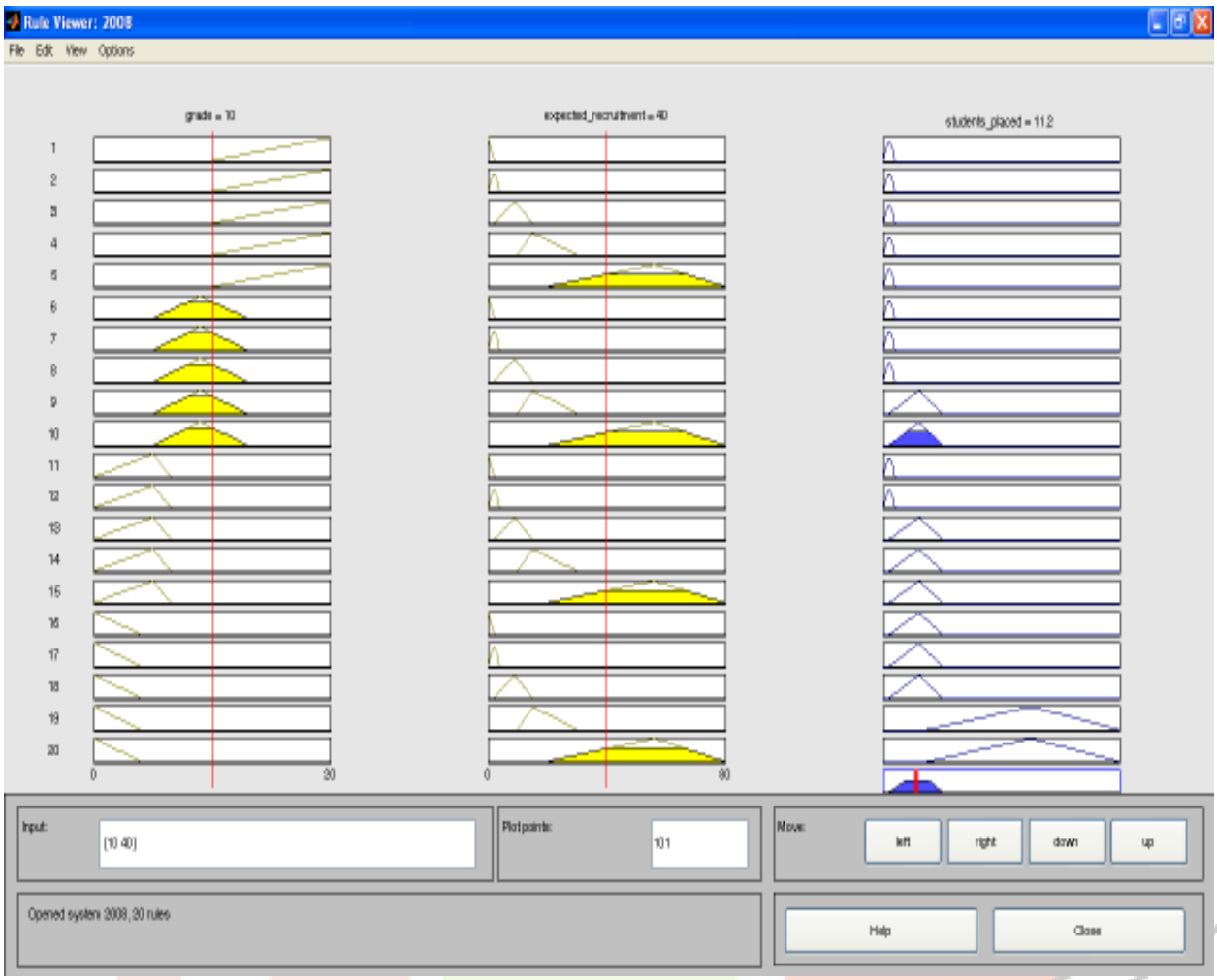




Step 3: Relational Rule

Grade of company (↓)	Expected recruitments (→)	Very low	Low	Medium	High	Very High
S		Low	Low	Low	Low	Low
A+		Low	Low	Low	Medium	Medium
A		Low	Low	Medium	Medium	Medium
B		Medium	Medium	Medium	High	Very high

Step 4: Rule Viewer to predict the Result (Placement 2008)



6. Conclusion & Future Work

To summarize, the complete strategy for involving stakeholders in improving the quality of technical education offers a viable framework based on thorough study and active participation. The previous research has yielded significant knowledge regarding the intricacies of collaboration, pinpointed essential elements for achieving success, and constructed a strong framework that has been validated through preliminary trials. Nevertheless, it is crucial to recognize certain constraints, such as difficulties in extrapolation, possible reluctance to adapt, and external variables impacting the dynamics of collaboration. In order to overcome these constraints, future research should focus on customizing the approach to various educational settings, including cutting-edge technologies for communication and cooperation, and devising strategies to maintain long-term involvement despite external factors. Furthermore, conducting longitudinal studies that monitor the lasting effects of collaborative initiatives and the continual improvement of the framework in response to changing educational environments would help to continuously enhance the quality of technical education through collaboration among stakeholders.

Future Work

Future endeavors in improving the quality of technical education should prioritize many important areas by adopting a holistic strategy to stakeholder participation. First and foremost, it is necessary to conduct thorough scalability testing and modify the framework to accommodate a wide array of educational institutions, taking into account differences in size, structure, and cultural environment. It is crucial to adopt sophisticated technology to facilitate smooth communication and collaboration among stakeholders. In future projects, it is important to consider and utilize novel solutions to improve efficiency and effectiveness. Conducting longitudinal studies to monitor the long-term effects of joint projects would offer useful insights about the durability and adaptability of the framework. Furthermore, it is imperative to focus on devising tactics to overcome potential opposition to change and tackling deeply rooted customs inside educational institutions. By continuously improving feedback loops and conducting frequent audits, an adaptable and growing framework can be established to withstand external influences on the educational environment. In the end, future efforts should aim to improve, broaden, and customize the all-encompassing strategy for stakeholder participation, guaranteeing its pertinence and efficiency in ever-changing educational situations.

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