

The quality enhancement system improvement using the ANFIS method for segmentation of lecturer performance

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Abstract

Lecturers play a crucial role in developing skilled human resources. Classifying lecturer performance is believed to enhance the internal quality assurance system in the learning process and boost the scientific transformation process for students. This research aims to assess the effectiveness of using ANFIS as a classification approach for evaluating a lecturer's teaching ability. The study utilized a quantitative research method to evaluate the teaching performance of lecturers and a qualitative research method to analyze the internal quality assurance system at Universitas Muhammadiyah Jakarta. This study intends to use ANFIS to analyze instructor performance and pinpoint opportunities for enhancement in the college's internal quality assurance system. The study's findings suggest that ANFIS is an appropriate method for categorizing lecturers' performance, with an accuracy rate of 0.5. The insights can help pinpoint areas for development and guide actions to enhance the quality of education offered by the college. The study highlights the importance of using sophisticated approaches such as ANFIS to achieve continuous improvement and quality assurance in higher education institutions.

Keywords: ANFIS, lecturers evaluation; lecturers performance, quality assurance system

Abstrak

Dosen mempunyai peran penting dalam mengembangkan sumber daya manusia yang terampil. Pengklasifikasian kinerja dosen diyakini dapat meningkatkan sistem penjaminan mutu internal dalam proses pembelajaran dan mendorong proses transformasi keilmuan mahasiswa. Penelitian ini bertujuan untuk menilai efektivitas penggunaan ANFIS sebagai pendekatan klasifikasi untuk mengevaluasi kemampuan mengajar dosen. Penelitian ini menggunakan metode penelitian kuantitatif untuk mengevaluasi kinerja mengajar dosen dan metode penelitian kualitatif untuk menganalisis sistem penjaminan mutu internal di Universitas Muhammadiyah Jakarta. Penelitian ini bermaksud menggunakan ANFIS untuk menganalisis kinerja instruktur dan menunjukkan peluang peningkatan sistem penjaminan mutu internal perguruan tinggi. Temuan penelitian menunjukkan bahwa ANFIS merupakan metode yang tepat untuk mengkategorikan kinerja dosen, dengan tingkat akurasi 0,5. Wawasan ini dapat membantu menentukan area pengembangan dan memandu tindakan untuk meningkatkan kualitas pendidikan yang ditawarkan oleh perguruan tinggi. Studi ini menyoroti pentingnya penggunaan pendekatan canggih seperti ANFIS untuk mencapai perbaikan berkelanjutan dan jaminan kualitas di institusi pendidikan tinggi.

Kata kunci: ANFIS, evaluasi dosen, kinerja dosen, system penjaminan mutu

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Introduction

Indonesian education is faced with various challenges, both internal and external. With the rapid development of technology, it will have a major influence on the world of education. This is an external challenge for the world of education. Internal challenges, namely the efforts of educational institutions in carrying out planning, implementation, evaluation, monitoring, and improvement standards in the world of education. Every tertiary institution must follow the standardization of the educational process that is enforced in Indonesia. The national standards for higher education in Indonesia are contained in Ministerial Regulation No. 44 of 2015 concerning National Standards for Higher Education (Herni, 2022).

The Internal Quality Assurance System (IQAS) of a university refers to the processes and mechanisms put in place by the institution to ensure and enhance the quality of its academic programs, teaching, research, and overall operations (Herni, 2022). While IQAS aims to maintain high standards and continuously improve the quality of education provided by the university, there can be various challenges or problems that may arise within this system.

One of the fundamental problems in IQAS can be the lack of adequate resources, including financial, human, and infrastructural resources. Without sufficient resources, it becomes challenging for the university to implement effective quality assurance measures, such as hiring qualified staff, maintaining updated facilities, or conducting thorough evaluations of academic programs (Samudra & Sumada, 2021).

Sometimes, different departments or faculties within the university may have their own quality assurance processes, leading to fragmentation and lack of coherence in the overall IQAS. This fragmentation can result in inconsistencies in standards, assessment methods, and

reporting mechanisms across different areas of the university (Pawan et al., 2021).

Implementing changes or improvements to the IQAS may face resistance from various stakeholders within the university, including faculty, administrators, and staff. Resistance to change can stem from concerns about workload increase, fear of the unknown, or disagreement with proposed changes, which can hinder the effective implementation of quality assurance initiatives (Alzafari & Ursin, 2019).

Effective quality assurance relies on the collection, analysis, and utilization of relevant data to inform decision-making and improvements (Bendermacher et al., 2019). However, some universities may struggle with collecting sufficient data or may not effectively utilize the data they gather, leading to limited insights into areas needing improvement or opportunities for enhancement.

Quality assurance should involve input and collaboration from various stakeholders, including students, faculty, administrators, employers, and external accrediting bodies (Aburizaizah, 2022). However, universities may face challenges in engaging these stakeholders effectively, leading to a lack of diverse perspectives and potential blind spots in quality assurance efforts.

Faculty and staff involved in implementing quality assurance processes may lack adequate training or awareness about the importance and methodologies of IQAS (Stukalo & Lytvyn, 2021). Without proper training, individuals may struggle to effectively carry out their responsibilities or may not fully understand the objectives of quality assurance initiatives.

Research on lecturer performance has also been carried out by Yahya & Hidayati, (2015). This study showed that pedagogic competence, professional competence, personality competence, and social competence all increased

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simultaneously by 65.3%, a very significant effect. Research on quality assurance was also carried out in 2017 by Muh.Fitrah, Ruslan, and Hendra, demonstrating the implementation of the internal quality assurance system in higher education is of paramount importance in enhancing the overall quality of education. This ensures that graduates meet the expectations of stakeholders and are well-prepared for the demands of the professional world. (Fitrah et al., 2018).

Previous research on quality assurance included qualitative research using the case study method (Sulaiman & Wibowo, 2016). The results of this study show: (1) The SPMI policy and concept are academic documents and quality documents prepared by KJM UGM; (2) KJM UGM serves as coordinator in planning and implementing SPMI in all universities; (3) SPMI implementation is carried out by drafting the SPMI Cycle; (4) Obstacles faced: leadership commitment, number of auditors, SPMI activities becoming routine; (5) Steps taken: providing quality assurance experts, training auditors, building a spirit of quality assurance; (6) SPMI Implementation Evaluation is carried out every year; (7) Utilisation of SPMI Implementation Results: building a culture of quality, national and international accreditation and certification; and (8) Development of SPMI Implementation refers to ISO quality management and applies BAN and PT standards. The significance of an internal quality assurance system lies in the value it adds when the findings are utilized by program planners and implementers to drive continuous improvements in the future (Yang et al., 2020). SPMI was established as a framework for effectively managing the quality of higher education in accordance with national standards and government regulations in the Republic of Indonesia.

Lecturer performance research uses the concept of data mining, which was carried out by Oman Somantri and Slamet

Wiyono with the title Increasing Accuracy of Classification Level of Mastery of Teaching Materials (Apriliani & Somantri, 2019). Using artificial neural networks (Afriliana et al., 2017) and genetic algorithms in 2017 resulted in the optimization of ANN algorithms using GA, which has been able to produce increased accuracy in the classification of teaching materials for assessing the performance of lecturers and students (Afriliana et al., 2017).

Because the classification of lecturer performance to improve the internal quality assurance system in the learning process is expected to improve the scientific transformation process for students (Cao et al., 2022). As it is known that ANFIS is a fairly good classification method (Pekala, 2019), this research will determine the extent to which this method can classify a lecturer's teaching performance.

Method

The research methods used were a quantitative research method (Adedoyin, 2020) to classify the teaching performance of lecturers and a qualitative research method to carry out document analysis of the internal quality assurance system at the Universitas Muhammadiyah Jakarta. The framework used for this research can be seen in Figure 1. In this study, data collection was carried out by observing and interviewing the Faculty of Engineering, Universitas Muhammadiyah Jakarta, for undergraduate programmes, where in this unit there are several study programme quality assurance groups that function as an extension of the SPMI implementation arm within the study programme environment. The dataset is the result of a questionnaire on student reaction sheets on the learning process carried out by supporting lecturers during the 2021–2022 academic year, for a sample of undergraduate programmes at the Faculty of Engineering, Universitas

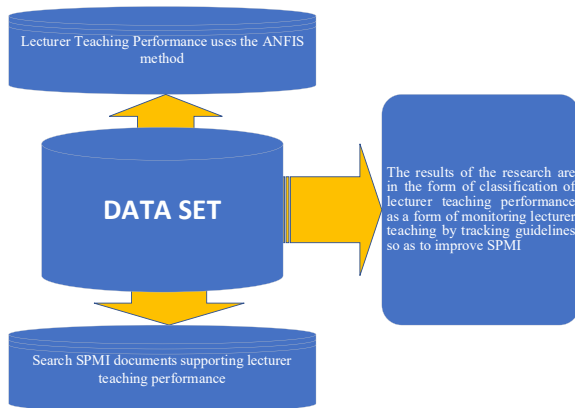


Figure 1. Research Framework

Muhammadiyah Jakarta.

The questionnaire data is still in the form of lecturer report cards, so data preparations must be made so that the data is ready for the next stage, namely data processing using data mining. Data mining processing in this study is the Sugeno fuzzy method (Sugeno & Kang, 1988) and the Adaptive Neuro Fuzzy Inference System (ANFIS) (Jang, 1993; Mishra et al., 2019). All data is processed using Matlab tools. After that, the document search for the internal quality assurance system at the Universitas Muhammadiyah Jakarta was traced, then analysed using descriptive analysis.

Result

The data from the supporting lecturers provides an overview of the teaching of the teaching lecturers in the Faculty of Engineering, Universitas Muhammadiyah Jakarta, for undergraduate programmes, namely, that with a scheme, one subject can be taught by more than one lecturer because there are 12 classes per class. Thus, since one lecturer in charge of the course can only teach 2-3 classes, it is necessary to coordinate between lecturers in charge of the same subject to unify the syllabus and output competencies for each course. From the lecturer's report card, the variables are then selected for the implementation of fuzzy sugono. For fuzzy

Sugeno, and then ANFIS is carried out using 6 variables, namely:

- a. Variable P1 is the existence of a syllabus, an explanation of the syllabus to students, and the suitability of the syllabus with the teaching materials.
- b. Variable P2 is the lecturer's mastery of teaching materials and practise in the laboratory or project.
- c. Variable P3 is a teaching method in which the results of the assessment of this variable can be taken from the average value of X7 and X8.
- d. Variable P4 is openness to criticism from students during the learning process.
- e. Variable P5 is the discipline of the lecturer during the learning process.
- f. Variable P6 is an administrative assessment of the learning process by the administrative officer of the Faculty of Engineering, Universitas Muhammadiyah Jakarta.

Discussion

Logika Fuzzy

The implementation of Fuzzy Sugeno on lecturer teaching performance data using these 6 variables was carried out with 5 different experiments, namely differentiating the universe of sets and curves used and generating a different number of rules in each experiment. The types of curves implemented in lecturer teaching performance data are trapmf, trimmf, gbellmf, gaussmf, and dsigmf. And the rules that were generated were 33 and some were 34. The results of the five experiments can be seen in Table 1.

From the simulation results, it can be seen that the plots produced in the fourth experiment are shown in Figure 2. From the figure, it can be seen that the inputs P1 (the existence of a syllabus) and P2 (lecturer's mastery of teaching materials) contribute maximum to the achievement of lecturer performance. The further step

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Table 1. Results of lecturer performance classification with fuzzy sugeno

Method	Discussion result				
	1st Fuzzy Experiment	2nd Fuzzy Experiment	3rd Fuzzy Experiment	4th Fuzzy Experiment	5th Fuzzy Experiment
Lecturer Teaching Performance	0,5	0.5	0.506	0.5	0.5
Number of Rules	33	33	34	34	34

Resource: Analysis Result.

will proceed to the next stage, namely ANFIS.

ANFIS

The fuzzy inference system is a linguistic system that is easy to understand and can be run on a backpropagation algorithm based on input-output data pairs using an artificial neural network architecture. This method uses a fuzzy logic system. The combination of a neural network (artificial neural network system) with a fuzzy system is called the Adaptive Neuro Fuzzy Inference System (ANFIS).

The study utilized ANFIS to classify lecturer teaching performance by conducting the 4th fuzzy Sugeno experiment. This experiment involved 6 inputs and 1 output, which is the classification of lecturer teaching performance. It generated 34 rules and achieved a classification result of 0.5. The ANFIS structure, which is the outcome, is

displayed in Figure 3 and exhibits high accuracy.

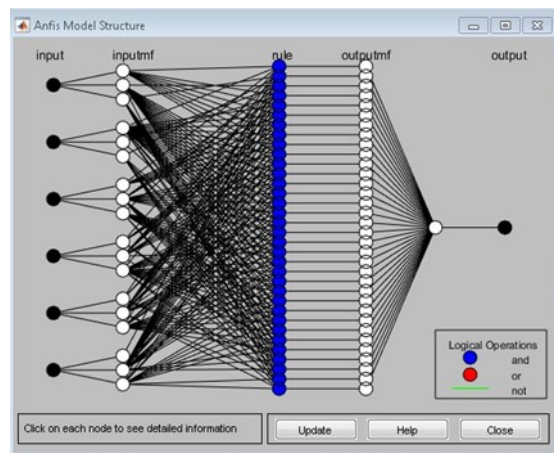


Figure 3. Structure of ANFIS Lecturer Teaching Performance

Conclusion

The internal quality assurance system at Muhammadiyah University of Jakarta is carried out by the P2M Unit, and for each study programme there is a quality assurance group coordinator. Study programme quality assurance group as an extension of the P2M unit that will carry out quality assurance at the study programme level, which is expected to be able to carry out determination, implementation, evaluation, control, and improvement in various standard guidelines that have been determined in accordance with Ministerial Regulation No. 44 2015. Documents relevant to research on lecturer performance can be found in books 3 (SPMI Learning Process), 5 (SPMI Lecturers and Education

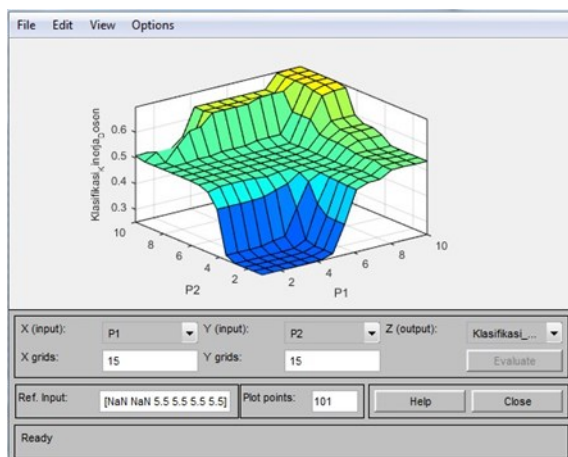


Figure 2. Lecturer Teaching Classification

Personnel), and 7 (SPMI Learning Management).

From the research conducted, the teaching performance of lecturers will affect the quality of the learning process, one of which can improve internal quality assurance, namely by carrying out lecturer performance evaluations, which are carried out every semester, then the results are analyzed, which then becomes a guideline for controlling and improving lecturer performance in the academic year next year.

In this study, data on lecturer performance assessments for 2021–2022, resulting from P2M at the undergraduate programmes of the Faculty of Engineering, Universitas Muhammadiyah Jakarta, were implemented using Fuzzy Sugeno Logic and the ANFIS method to classify lecturer teaching performance. The results of the analysis obtained from the implementation indicate that ANFIS is suitable for classifying lecturer teaching performance. From the model obtained using the ANFIS method, it was found that the existence of a syllabus and lecturer's mastery of teaching materials contributed significantly to achieving lecturer performance.

This classification needs to be done for each lecturer's teaching performance assessment, even though so far this has been done with SPSS or Ms. Excel, but data mining like the ANFIS method can be used as a good classification method.

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