


# Students' Performance Prediction in Higher Education Using Multi-Agent Framework-Based Distributed Data Mining Approach: A Review

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## ABSTRACT

An effective educational program warrants the inclusion of an innovative construction that enhances the higher education efficacy in such a way that accelerates the achievement of desired results and reduces the risk of failures. Educational decision support system has currently been a hot topic in educational systems, facilitating the pupil result monitoring and evaluation to be performed during their development. In this literature survey, the authors have discussed the importance of multi-agent systems and comparative machine learning approaches in EDSS development. They explored the relationship between machine learning and multiagent intelligent systems in literature to conclude their effectiveness in student performance prediction paradigm. They used the PRISMA model for the literature review process. They finalized 18 articles published between 2014-2022 for the survey that match the research objectives.

## KEYWORDS

Classification, Computational Intelligence, Distributed Data Mining, Educational Data Mining, Higher Education, Multi-Agent System, Prediction

## INTRODUCTION

Predicting students' performance with a reasonable degree of accuracy is beneficial in finding the students who perform poorly when the learning process begins. The main objective of any educational institution is to render the best chances for education and skills for the students. To reach this goal, it is essential to recognize that students need extra help and meaningful steps to improve their results.

Malaysia is experiencing a moderate increase in the unemployment rate each year. The projected unemployment rate for 2017 is 3.42221%. Future unemployment will rise slightly over the next ten years. Then the remaining four years began to grow at a rate of at least 3.8 per cent from 2023

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to 2026 (Ramli et al., 2018). This is a highly alarming figure, given that the findings indicate that unemployed graduates from public universities have the highest unemployment rate. However, the education sector has also revealed that unemployment has increased. The first objective is to analyze the critical variables affecting Malaysia's unemployment rate. According to the results, general factors such as inflation and population growth in Malaysia significantly impact the unemployment rate. In short, graduate students need to understand the situation and prepare for the uncertainty associated with this unemployment. Governments must also be accountable for taking appropriate action to tackle unemployment and not affect other social and economic conditions.

Today, due to the tremendous importance of this topic for the advancement of nations globally, the prediction of student performance is becoming increasingly significant. The educational process is entirely dependent on producing generations that are capable of leading this country and its steps toward progress in every area (scientific, economic, social and military, etc.). Consequently, one of the key criteria that motivate governments to ensure that academic institutions represent vast and scrupulous efforts to move the academic process towards continuous and improving advancement is advancing the academic process. Prediction can help in getting future knowledge. The more the volume of data is, like in massive databases, the more the forecasting is generated; this process is referred to as data mining which helps find the concealed information by examining various data sources associated with diverse domains, including social enterprises, healthcare, and academics (Chen et al., 2020; Miguéis et al., 2018). Relevant information is extracted for analyses of academic sources using EDM (Educational Data Mining), a new discipline for discovering important information using technology (Bakhshinategh et al., 2018).

The efficacy of learning environments improves as a result of statistical analysis and deep learning analysis. There has been a rapid increase in the significance of EDM currently due to the rise in the data gathered, based on the academic data obtained from various e-learning systems, along with the progress made in conventional academic systems. It is a kind of education in which the emphasis is on the instructor rather than the students, and it has drawbacks such as large class sizes, a lack of individual attention, and the use of traditional teaching tools such as black and whiteboards, desks, and pens. EDM's strengths rise from linking data from different domains. It is involved with feature extraction to help in the development of the academic process from the tremendous amount of data that the institute provides. Educational data mining refers to the processes of analyzing, investigating, forecasting, clustering, and classifying data found in educational institutions. (Chen et al., 2018).

In contrast to the traditional database search, which may answer questions like, "That is the ward who failed the exam?" EDM can answer complex questions, such as predicting whether or not a student will pass an exam. Educational organizations attempt to develop a model of their student for the prediction of both the features and performance of every student separately (El Aissaoui et al., 2019). Hence, the scholars working with the EDM domain make use of diverse approaches of data mining for evaluating the lecturers, to lead their educational institutes. As due significance is not given to forecasting the performance of students in the present academic systems, these systems are bogged down due to a deficit of efficiency. The procedure of estimating the lessons, which the student might find interesting and having knowledge of his activity in academic organizations helps increase the educational efficacy. Many academic institutions are using MLTs (machine learning techniques) and EDM to assess their student's performances. These assessment systems are quite practical in enhancing student performance and also the entire academic process (Cuevas et al., 2018).

Currently, a distributed database is of immense help by considering the strong features used in the variety of its applications. Data is considered the key feature of any academic institution for having safe and right control of organizational data. In the last few years, educational data mining (EDM) has gained much focus among scholars in improving the quality of higher education.

This paper presents a study on the factors that influence the academic performance of higher education students and develops a classification model that utilizes both single and ensemble-based classifiers to predict student performance. The ensemble model combines different techniques to

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