

# Online Student Monitoring and Evaluation System using Apriori Algorithm for Predicting Student Academic Performance

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**Abstract:** *The study investigates the current student monitoring and evaluation system of Saint Michael College of Caraga with the goal of easy tracking of student academic performance and progression. The research employs a mixed-methods approach through the conduct of interview and utilizing online survey questionnaire. The perspectives of young female students regarding the current system and their suggestions for improvement were examined and analyzed using descriptive statistical method such as frequency distribution, weighted mean score, and standard deviation. The key findings indicate a generally positive perception of the existing system but highlight areas for improvement including addressing technical issues, accommodating diverse learning styles, ensuring system security and privacy, and providing personalized support to students. By engaging stakeholders and incorporating diverse viewpoints from the respondents, the research output contributes to the development of a robust monitoring and evaluation system capable of optimizing academic performance assessment and enriching the educational experience. The integration of Apriori Algorithm fosters informed decision-making for attaining student's academic success.*

**Keywords:** Online Student Monitoring and Evaluation System, Academic Performance, Mixed-Methods Approach, Qualitative Research, Quantitative Research, Stakeholder Engagement, Educational Experience, System Optimization

## I. INTRODUCTION

It is the primarily goal of every higher education institution to produce students who can readily fulfil their role in the society. These students are likewise expected to contribute to the country's social and economic development [7]. Indeed, it is a continuous challenge to maintain the quality of students by regularly monitoring and evaluating their academic performance. However, the academic performance of students is affected by psychological, economic, social, personal, and environmental factors. Many of the previous studies on academic performance of students focused on such issues such as teacher education, class environment, gender difference, teaching style, family educational background and socioeconomic factor. The majority of the researchers also utilize GPA (grade point average) to assess evaluate performance of the students in a particular semester [6].

As it is considered important to keep track on the how well students are doing in their studies, Saint Michael College of Caraga is faced with some challenges in doing this effectively. The current methods of tracking and evaluating student performance fall short of providing the valuable information that the college need [1]. It results to the difficulty of the teachers and school leaders to make decisions that can help students learn better and progress accordingly.

To address the gap, the researchers intend to create a new system that utilizes modern technology and machine learning to make it easier for SMCC to monitor and evaluate student performance across all levels. By doing this, the proposed system can provide teachers and school leaders relevant and timely information for making informed decision for providing quality of education and better learning experience for the students.

### 1.1 Objectives of the Study

The objectives of the study can be formulated as follows:

- To assess the current student academic performance monitoring and evaluation of Saint Michael College of Caraga.
- To propose an Online Student Monitoring and Evaluation System using Apriori Algorithm for Saint Michael College of Caraga
- To formulate recommends for further improvement of Student Monitoring and Evaluation System at SMCC.

## III. RELATED LITERATURE

### 2.1 Student Academic Achievement

Academic achievement represents performance outcomes that indicate the extent to which a person has accomplished the requirements and achieve the learning outcomes of an educational program offered by academic in. School systems mostly define cognitive goals that either apply across multiple subject areas (e.g., critical thinking) or include the acquisition of knowledge and understanding in a specific intellectual domain (e.g., numeracy, literacy, science, history). Therefore, academic achievement should be considered to be a multifaceted construct that comprises different domains of learning. Because the field of academic achievement is very wide ranging and covers a broad variety of educational outcomes, the definition of academic achievement depends on the indicators used to measure it [9]. Among the many criteria that indicate academic achievement, there are very general indicators such as procedural and declarative knowledge acquired in an educational system, more curricular based criteria such as grades or performance on an educational achievement test, and cumulative indicators of academic achievement such as educational degrees and certificates [8].

### 2.3 Monitoring and Evaluation of Student Academic Performance

Monitoring and evaluation of students' knowledge and intellectual development is important at the national level. At the same time, the process of monitoring and evaluation affects the development and upbringing of the student's personality. Assessment is the process of measuring the level of achievement of learning objectives at a certain stage of the educational process on the basis of predetermined criteria, identifying and analyzing the results [2]. Checking and assessing the acquisition of learning materials, skills and competencies by learners is a necessary part of the learning process. It is not only about monitoring learning outcomes, but also guiding learners 'learning activities at different stages of the learning process [5].

### 2.4 Predicting Student Performance

Student academic performance in higher education (HE) is researched extensively to tackle academic underachievement, increased university dropout rates, graduation delays, among other tenacious challenges [10]. In simple terms, student performance refers to the extent of achieving short-term and long-term goals in education [11]. However, academicians measure student success from different perspectives, ranging from students' final grades, grade point average (GPA), to future job prospects [12]. The literature offers a wealth of computational efforts striving to improve student performance in schools and universities, most notably those driven by data mining and learning analytics techniques [13]. However, confusion still prevails regarding the effectiveness of the existing intelligent techniques and models.

### 2.5 Algorithm

The algorithm, a building block of computer science, is defined from an intuitive and pragmatic point of view, through a methodological lens of philosophy rather than that of formal computation. The treatment extracts properties of abstraction, control, structure, finiteness, effective mechanism, and intentional aspects of goal and preconditions. The focus on the algorithm as a robust conceptual object obviates issues of correctness and minimality. Neither the articulation of an algorithm nor the dynamic process constitutes the algorithm itself. Analysis for implications in computer science and philosophy reveals unexpected results, new questions, and new perspectives on current questions, including the relationship between our informally construed algorithms and Turing machines [35].

## 2.6 Apriori Algorithm

Data mining or knowledge discovery is the process of discovering patterns in large data sets. In data mining each algorithm has a different objective and to obtain meaningful and previously unknown patterns from large dataset is an emerging and challenging problem. Association rule mining is a technique for discovering unsuspected data dependencies and is one of the best-known data mining techniques. The basic Idea to identify from a given database, consisting of item sets (e.g. shopping baskets), whether the occurrence of specific items, implies also the occurrence of other items with a relatively high probability. Apriori algorithm is one of the popular approaches which are used to extract association rules from data sets. One of the most popular data mining approaches is to find frequent item sets from a transaction dataset and derive association rules. In the paper of Hill, R. K., the researcher describes the association rules which are descriptive data mining technique. This paper also addresses Apriori Algorithm and two other algorithms Record filter and Intersection Approach based on Apriori[14].

## III. METHODOLOGY

### 3.1 Research Design and Approach

The current exploration employed the descriptive research design using mix-methodology approach that incorporates both quantitative and qualitative method. The quantitative research used online survey that involves collecting numerical data to quantify relationships between variables. While the qualitative method focuses on exploring and understanding the current monitoring and evaluation of student performance through interviews. The qualitative research aims to uncover underlying meanings, patterns, and themes within the data.

### 3.2 Research Approach

This study adopts a mixed-methods research approach, combining qualitative to address the objectives of the study. The quantitative method was employed to gather data on system usability, effectiveness, and impact through online survey. Subsequently, the qualitative research approach using interview is suitable to gather in-depth insights from stakeholders (educators, administrators, students) about the challenges they faced in monitoring and evaluating student academic performance. This approach allows the exploration of diverse perspectives, experiences, and underlying reasons for the challenges encountered. This combined approach provides comprehensive insights understanding the respondents' needs, preferences, and requirements for the proposed system

### 3.3 Research Instrument

#### 3.3.1 Semi-structured interview

The personal interview allows the researchers to engage with the respondents (educators, administrators, students) in open-ended conversations to explore their perspectives, experiences, and challenges related to monitoring and evaluating student academic performance. Researchers used a predefined set of questions while also allowing for flexibility to probe deeper into specific issues raised by participants.

#### 3.3.2 Online surveys questionnaire

The online survey questionnaire through Google Form was used to gather feedback from the respondents regarding their preferences, requirements, and expectations for the proposed system. The surveys include Likert-scale questions to assess the importance and satisfaction levels of the current system.

### 3.4 Participation of the Study

The research participants include educators, administrators, educational technologists, and students. A total of 83 respondents successfully completed the online survey. The educators are teachers or professors involved in teaching and assessing students. The administrators are school leaders overseeing academic programs. The education educational technologies are experts in educational technology and data analysis. The students also participated by sharing their experiences and preference.

### 3.5 Sampling Methods

A non-probability method using convenience sampling method was used in the study where participants were selected according to their convenience and availability in answering the online survey or undergoing personal interview.

### 3.6 Data Gathering Procedure

In data gathering procedure, the researchers used both primary and secondary sources. For the primary data were collected through survey, interview, and academic records. The online survey asked students and teachers questions about the processing of assessing student academic performance. The interview provided a chance to have deeper conversations with the key people, like teachers and school leaders, to understand their views on monitoring and evaluating student performance. Examining the academic records, like grades and attendance, provide insights on how the students are doing in class. The secondary data, which comes from existing sources, that included academic papers and reports from Saint Michael College of Caraga as well as online databases which provide information on best practices and challenges in assessing student performance and developing online monitoring systems.

### 3.7 Data Analysis

The quantitative data gathered from the online survey questionnaire was analyzed using statistical methods such as the computed frequency distribution, weighted mean, and standard deviation. Table 1.0 presents the guide to determine the agreement level of the respondents in terms of their assessment in the current student monitoring and evaluation process of SMCC.

Range of the Weighted Mean	Interpretation
4.51 – 5.00	Strongly Agree (for the questions asked)
3.51 – 4.50	Agree (for the questions asked)
2.51 – 3.50	Moderately Agree (for the questions asked)
1.51 – 2.50	Disagree (for the questions asked)
1.50 and below	Strongly Disagree (for the questions asked)

The qualitative data collected from interviews and open-ended survey questions were analysed using thematic analysis to find common themes and patterns in the response of the participants. This helped in further understanding the challenges and needs related to monitoring student performance.

## IV. RESULTS AND DISCUSSION

This chapter discusses the analysis and interpretation of the data gathered from participants' responses in answering the specific questions of the study.

### 4.1 Profile of the Respondents

Table 1.0 Profile of the Respondents in terms of Gender

Gender	Frequency	Percentage %
Male	36	43%
Female	47	57%
<b>Total</b>	<b>83</b>	<b>100%</b>

Table 1.0 presents the profile of the respondent according to gender. As can be seen on the table there are 36 or 43% of the respondent are male while 47 or 57% are female. This implies that majority of the respondents who participated in the survey are male.

Table 2.0 Profile of the Respondents in term of Classification

Classification	Frequency	Percentage %
Teacher	8	10%
Student	75	90%
<b>Total</b>	<b>83</b>	<b>100%</b>

Table 2.0 shows the profile of the respondent according to classification. Majority of the respondents are teachers, with 8 or 10% of the population while 75 or 90% are students. This implies that majority of the respondents' classification who participated in the survey are students.

Table 3.0 Profile of the Respondents in terms of Age

Age	Frequency	Percentage %
Below 25 years old	73	88%
25 years old -36 years old	9	11%
37 years old-47 years old	1	1%
47 years old and above	0	0%
<b>TOTAL</b>	<b>83</b>	<b>100%</b>

Table 3.0 presents the profile of the respondent according to Age. Many of the participants are below 25 years old comprising 73 or 88% of the population and 9 or 11% are 26-36 years old while 1 or 1% are 37-47 years old and none of the respondents is 47 years old above.

**4.2 The Assessment of the Current Monitoring and Evaluation of Student Academic Performance at Saint Michael College of Caraga**

As presented in Table 4.0 is the assessment of the respondents in the current system of monitoring and evaluating the student academic performance. The data shows a positive sentiment towards the assessment tools (WM = 4.34) used to evaluate student performance which respondents believe to be effective (WM = 4.24). There is an agreement on the frequency of analyzing data to identify trends and areas for improvement(WM = 4.23). There is a divided opinion on whether the current system adequately addresses diverse learning styles (WM = 4.20). The socioeconomic factors are acknowledged to significantly impact the accuracy of assessments (WM = 4.15). The students and parents express satisfaction with the feedback mechanisms used to communicate academic performance (WM = 4.12). There is a weaker agreement regarding whether technological barriers hinder efficient monitoring and evaluation(WM = 3.89). The average weighted mean (WM) score is 4.16, indicating a general agreement among the respondents on their assessment of the current system.

Table 4.0 The Respondents' Assessment on the Current System of Monitoring and Evaluating Student Academic Performance

Statement	WM	Description	Standard Deviation
The assessment tools (test questionnaire, LMS, etc.) are effective in evaluating the student's academic performance.	4.34	Agree	3.94
The current system for monitoring and evaluating academic performance is effective.	4.24	Agree	3.84
The frequency of academic performance data analysis for identifying trends and areas for improvement is satisfying.	4.23	Agree	3.83
The current system adequately addresses the diverse learning styles and needs of students.	4.20	Agree	3.80
Socio-economic factors significantly impact the accuracy of academic performance assessments.	4.15	Agree	3.75
The feedback mechanisms for communicating academic performance to students and parents are satisfactory.	4.12	Agree	3.72
There are technological barriers that hinder the efficient monitoring and evaluation of students' academic performance.	3.89	Agree	3.53
<b>Average weighted mean</b>	<b>4.16</b>	<b>Agree</b>	



Overall, the data suggests a generally positive perception of the system for monitoring and evaluating academic performance. However, there are areas for improvement, such as addressing technological barriers and ensuring the system considers diverse learning styles.

### 4.3 The Proposed Online Student Monitoring and Evaluation System of Saint Michael College of Caraga

#### 4.3.1 The Functions and Features of the Proposed System

The functions and features of the proposed system as suggested by the respondents were presented in Table 5.0. Based on the results, the most requested feature was a secured login for students, teachers, and administrators, with 26% of respondents expressing a desire for it. An overview of student performance and other relevant metrics ranked as the second most requested feature, with 23% of respondents expressing interest. The personal information, academic history, and contact details ranked as the third most requested feature, with 18% of respondents indicating a desire for it. The responsive design for access on various devices and robust data encryption and privacy measures were tied for fourth and fifth place, with 17% and 16% of respondents respectively expressing interest. Overall, the survey result suggests that respondents prefer an automated system that is secure, easy to use on a variety of devices, and protects their account privacy. They also want the system to provide easy access to information about student performance.

Table 5.0 Functions and Features of the Proposed System

Which functions and features would you like to see in the system?	Frequency	Percentage	Rank
Secure login for students, teachers, and administrators.	72	26%	1
Overview of student performance and other relevant metrics	63	23%	2
Personal information, academic history, and contact details.	48	18%	3
Robust data encryption and privacy measures.	44	16%	5
Responsive design for access on various devices.	45	17%	4
TOTAL	272	100%	

#### 4.3.2 Conceptual Framework of the Online Student Monitoring and Evaluation System using Apriori Algorithm

The conceptual framework for the proposed system is shown in Figure 1. It provides a structured approach to collecting, analyzing, and utilizing student academic performance data by leveraging data mining techniques. The users of the proposed system are the teachers and students, who are categorized based on their classification.

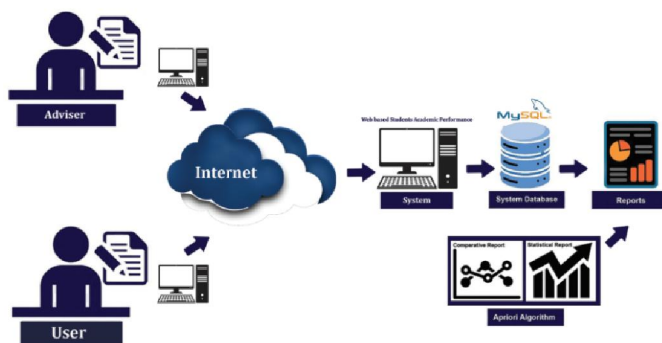
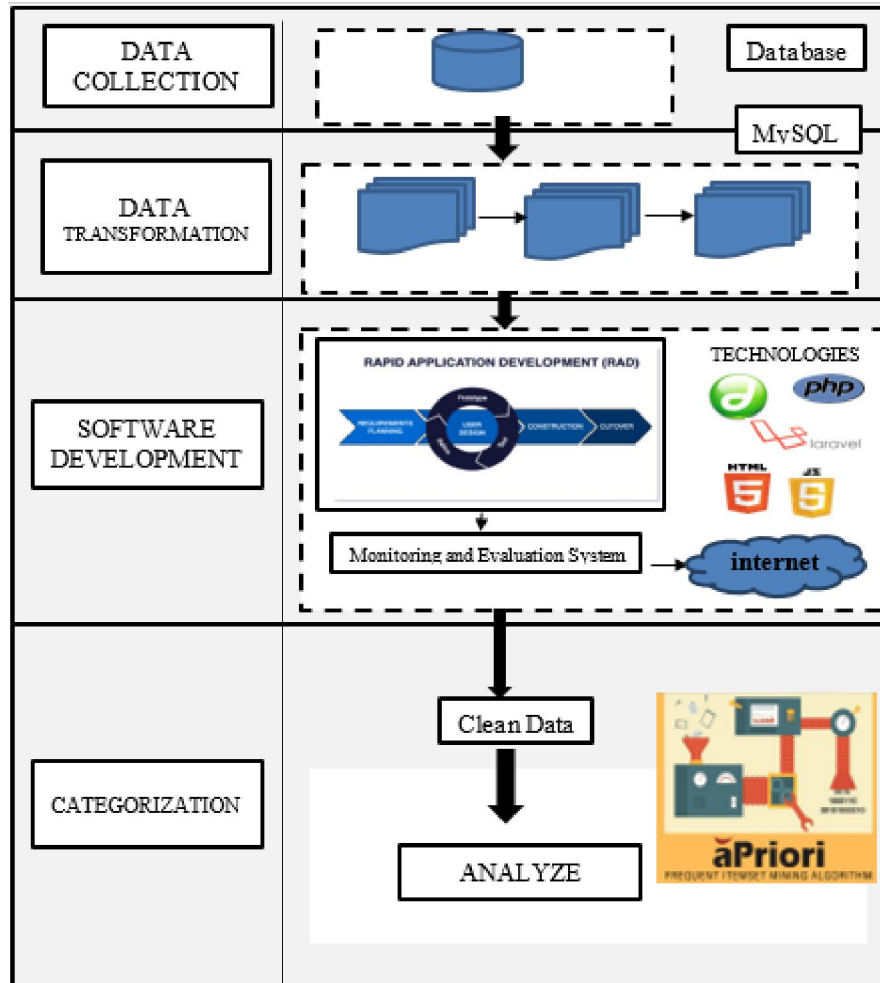


Figure 2. Conceptual Framework of the Proposed Online Student and Evaluation System using Apriori Algorithm

The proposed system allows users to access the online system after they input the correct information provided by the admin. The student accounts can be used by parents so they can monitor academic performance. Teachers and the department heads can track student academic performance more easily to assess the students' progress. This will help improve the way student progress is monitored and evaluated, ultimately leading to better support for student learning and success.

4.3.3 Development Architecture of the Online Student Monitoring and Evaluation System Using Apriori Algorithm.



**Figure 3. The Development Architecture of the Proposed System**

The development architecture of the proposed system is presented in Figure 3. It shows the steps of Knowledge Discovery in Database (KDD) in extracting patterns from the existing database. The development architecture design consists of four stages which are data collection, data transformation, software development, and pattern extraction. The different parameters, data mining methods, and tools are also considered. The technologies that are used in the development of the system are also shown. The system interfaces are designed using Adobe Dreamweaver, HTML (Hyper Text Markup Language), and CSS (Cascading Style Sheet); MySQL is used to manipulate and access the database; PHP and jQuery are used for coding the system.

**4.4 Suggestions and Recommendation for the Enhancement and Improvement of Monitoring and Evaluating the Students' Academic Performance at Saint Michael College of Caraga.**

The respondents have revealed several specific recommendations to enhance and improve the Student Monitoring and Evaluating for the Students' Academic Performance system of Saint Michael College of Caraga. They recommended a robust system for tracking academic progress in real-time. This system is expected to help teachers, students, and parents identify areas needing improvement early on. Additionally, the system can offer offering personalized feedback sessions and academic support services like tutoring and counselling will assist struggling students. The regular formative assessments will give continuous insights into students' learning, enabling teachers to tailor instruction accordingly. Implementing the feedback mechanisms, periodic performance reviews, and data analytics tools will

further enhance monitoring and intervention strategies. Keeping parents involved through updates and conferences will also contribute to student success. By creating a comprehensive monitoring system and fostering open communication, the study will better address students' diverse needs and promote their academic growth effectively.

## V. CONCLUSIONS AND RECOMMENDATIONS

The study examined at how Saint Michael College of Caraga monitor and evaluate student academic performance. Most respondents believed that the current system works well, and they have high level of agreement in terms of the use of assessment tools and accommodating learning styles of the students. They believed that quizzes, examination, and online tools used for evaluation work great. However, some have expressed difficulty in assessing student academic performance accurately due to some technological barrier. With this, it is recommended to conduct regular checking of the proposed system's functionality, usability, and performance to identify any areas for improvement or optimization. This is to ensure that the proposed system remains up-to-date and aligned with the evolving needs of stakeholders. The implementation of user feedback mechanism on their experiences can foster a sense of ownership and encourages continuous improvement. It is also suggested to provide training and support to the users to maximize their proficiency in utilizing the system effectively. Additionally, provide timely technical support to address any issues or challenges encountered during system usage.

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## REFERENCES

- [1] Sorour, S. E., Mine, T., Goda, K., & Hirokawa, S. (2015). A predictive model to evaluate student performance. *Journal of Information Processing*, 23(2), 192-201.
- [2] Vaccaro, D. T., & Sabella, L. D. (2018). Impact on student learning: monitoring student progress. *Journal of Practitioner Research*, 3(1), 5.
- [3] Asiah, M., Zulkarnaen, K. N., Safaai, D., Hafzan, M. Y. N. N., Saberi, M. M., & Syuhaida, S. S. (2019). A review on predictive modeling technique for student academic performance monitoring. In *MATEC Web of Conferences* (Vol. 255, p. 03004). EDP Sciences.
- [4] Ogor, E. N. (2007, September). Student academic performance monitoring and evaluation using data mining techniques. In *Electronics, robotics and automotive mechanics conference (CERMA 2007)* (pp.354-359). IEEE.
- [5] Furnham, A., Nuygards, S., & Chamorro-Premuzic, T. (2013). Personality, assessment methods and academic performance. *Instructional science*, 41, 975-987.
- [6] Singh, S. P., Malik, S., & Singh, P. (2016). Research paper factors affecting academic performance of students. *Indian Journal of Research*, 5(4), 176-178.
- [7] Ali, N., Jusoff, K., Ali, S., Mokhtar, N., & Salamat, A. S. A. (2009). The factors influencing students' performance at University TeknologThe researcher MARA Kedah, Malaysia. *Management Science and Engineering*, 3(4), 81.
- [8] Singh, K. (2011). Study of achievement motivation in relation to academic achievement of students. *International Journal of Educational Planning & Administration*, 1(2), 161-171.
- [9] Namoun, A., & Alshantiti, A. (2020). Predicting student performance using data mining and learning analytics techniques: A systematic literature review. *Applied Sciences*, 11(1), 237.
- [10] Daniel, B. (2015). Big data and analytics in higher education: Opportunities and challenges. *Br. J. Educ. Technol.* 46, 904-920.
- [11] Zohair, L.M.A. (2019). Prediction of student's performance by modelling small dataset size. *Int. J. Educ. Technol. High. Educ.* 16, 27.



- [12] Hellas, A., Ithantola, P., Petersen, A., Ajanovski, V.V., Gutica, M., Hynninen, T., Knutas, A., Leinonen, J., Messom, C., & Liao, S.N. (2018). Predicting academic performance: A systematic literature review. In Proceedings of the Companion of the 23rd Annual ACM Conference on Innovation and Technology in Computer Science Education, Larnaca, Cyprus, 2–4 July 2018; pp. 175–199.
- [13] Baradwaj, B.K., & Pal, S. (2012). Mining educational data to analyze students' performance. *Int. J. Adv. Comput. Sci. Appl.* 2, 63–69.
- [14] Hill, R. K. (2016). What an algorithm is. *Philosophy & Technology*, 29, 35-59.
- [15] Bhargava, M., & Selwal, A. (2013). Association Rule mining using Apriori Algorithm: A Review. *International Journal of Advanced Research in Computer Science*, 4(1).