DALAN: A COURSE RECOMMENDER FOR FRESHMEN STUDENTS USING A MULTIPLE REGRESSION MODEL

Michaelangelo R. Serrano, Nero L. Hontiveros, EJ Ryle C. Mosquera, Riza Lenn L. Cariaga, Novannyza Bein D. Catulong

College of Information Technology and Engineering, Notre Dame of Midsayap College, Midsayap, Cotabato, Philippines

ABSTRACT

It is challenging for the institution to provide students with ideas about courses or programs to pursue. This study aims to propose a tool that employs multiple regression to forecast incoming college students' courses at Notre Dame of Midsayap College. The proponents developed a prediction model based on the identified predictors and Cumulative Semestral Grade Point Average of all College of Information Technology and Engineering students from the first semester of S.Y. 2013-2014 to S.Y. 2015-2016, using the ex post facto method. The necessary variables were Entrance Exam results, High School Grade Point Average, and Cumulative Semestral Grade Point Average. Also, Pearson's R correlation was used to determine the relationship between EE and HSGPA to CSGPA. Conclusively, this study supported the notion that EE and HSGPA considerably impact CSGPA. Additionally, the developed predictive model was considered appropriate for course recommendation.

KEYWORDS

course recommender; multiple regression; prediction model; academic performance, predictors

1. INTRODUCTION

Data mining uses various statistical methodologies and different algorithms, like classification models, clustering, and regression models, to exploit the insights present in the large set of data [1]. Data mining analyzes a large batch of information to discern patterns and trends [2]. Furthermore, data mining can be used in various fields like research, business, sales, marketing, product development, healthcare, and education [3].

A university in Japan conducted a study [4] and developed a system to help students manage their study progress more effectively. According to the author, students would perform better and find it simple to choose courses without worrying about which one will give them excellent ratings for their intended job or career path.

In the Philippines, a study used Educational Data Mining and defined three data mining classification models to analyze the data set and predict students' performance. These are Decision Trees, Naïve Bayes, and Deep Learning in Neural Networks. Their paper presents the outcomes of linking an EDM approach to model students' academic performance [5].

The Guidance Office at Notre Dame of Midsayap College has used manual services for first-year students to recommend courses. Freshmen students must have an interview at the Guidance Office for consultation and course recommendation during enrollment. However, there is no automated system that the NDMC Guidance Office uses for course recommendations.

It is time-consuming to use manual services to identify students' specializations from their interest tests and guide them on which courses are most suited.

As a result, a course recommender system based on the concepts of EDM is developed to answer the abovementioned problem. *Dalan* will be a tool to automate and speed up the process to accommodate freshmen students in the Guidance Office. A course recommender system is essential in predicting the course selection of the student. The tool mainly aims to help students with their enrollment decisions. More specifically, it provides recommendations for selective and optional courses concerning students' skills, knowledge, and interests [6]. *Dalan* is a Visayan word for way or path [7][8], hence the name of the tool used for the course recommendation. Additionally, *Dalan* will use Multiple Regression [9]. Since multiple regression can forecast a dependent variable with two or more predictors, it can be employed in this study.

The research was conducted only at Notre Dame of Midsayap College. The data were collected from the College of Information Technology and Engineering department and used as the basis for the course recommendation. The data were analyzed using Multiple Regression to produce results and recommend the course. In this study, the High School Grade Point Average (HSGPA) and the Entrance Exam Result (EE) from the first-year students were analyzed to solve for the College Semestral Grade Point Average (CSGPA).

1.1. Theoretical Framework

This study is based on Pearson's statistical theory of multiple regression [10]. Multiple regression generally explains the relationship between multiple independent or predictor variables and one dependent variable. The regression algorithm estimates the state of the response as a function of the predictors for each case in the build data. These relationships between predictors and target are summarized in a model, which can then be applied to a different data set in which the target values are unknown [10].

The study aims to develop a tool that uses multiple regression analysis in data mining to examine and compute the CSGPA of CITE freshmen students as a measure of their academic performance and as the basis for course recommendations.

1.2. Conceptual Framework

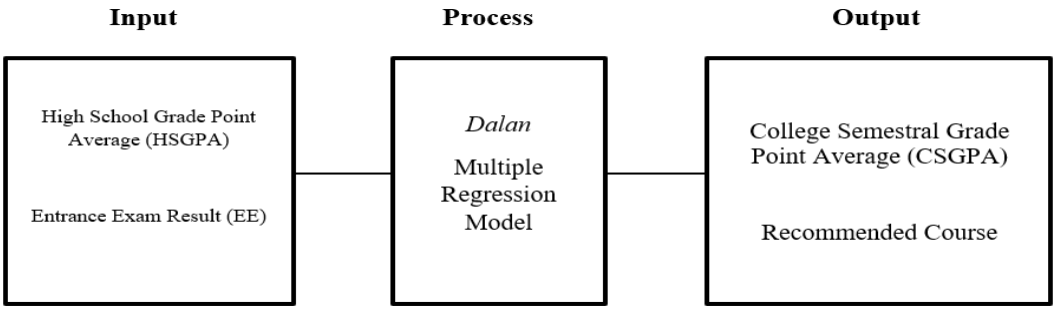

Fig. 1 Conceptual Framework of *Dalan*

Figure 1 presents the conceptual framework of the study using the Input-Process-Output (IPO) model.

Training data were gathered for the input, consisting of the High School Grade Point Average (HSGPA) and Entrance Exam Result (EE). The data will be processed using *Dalan*, which uses a Multiple Regression Model to develop a predictive model based on the training data. Lastly, the output contains the College Semestral Grade Point Average (CSGPA), which is the result of the analyzed data from the training data using the predictive model. The predictive model was utilized to design the *Dalan* tool to recommend a course for the incoming freshmen of the NDMC.

2. RELATED WORKS

2.1. Educational Data Mining

Student Performance Prediction (SPP) aims to evaluate the grade a student will reach before taking an exam or enrolling in a course. The work discusses new developments and challenges in studying student performance predictions and how personalized education can be advanced [11]. Studying and analyzing educational data, especially student performance, is essential [12]. Educational Data Mining (EDM) is concerned with mining educational data to find interesting patterns and knowledge in educational organizations [12].

In this study, *Dalan* uses EDM to predict courses that can help students choose suitable courses and plan for academic periods. Academic success in students can be defined in many ways, often from challenging angles, yet quantitative evaluations are crucial in today's educational institutions. Student performance prediction will be the basis on which data mining techniques can be applied to predict or recommend courses to CITE freshmen college students.

2.2. Course Recommender

In recommender systems, especially in taking users' preferences, uncertainty cannot be ignored [13]. The researchers use fuzzy logic; uncertainty issues could be handled to support recommender systems in giving accurate recommendations with effective and efficient results as presented in, even in career counseling, as well as to analyze students' academic performances [13]. The recommender system is essential for a student's future success. Different factors must first be considered to identify and deal with this diverse and vast amount of student data. Computational time and complexity issues must also be considered to produce a quality prediction model. Researchers used text mining, clustering, classification, association rule mining, and other data mining techniques in the context of education. Fuzzy logic solves problems by taking into account all relevant information and choosing the best course of action given the input. [12]. In India, a course recommender model was designed to consider the students' characteristics to recommend appropriate courses [14]. The model uses clustering to identify students with comparable interests and skills. Once similar students are found, fuzzy association rule mining examines dependencies between student course selections. They apply clustering and fuzzy association rules resulting in appropriate recommendations and a predicted score [14].

This study developed *Dalan* as a course recommender system based on the entrance examination results, grades, performance, and student's interests. It uses Multiple Regression analysis to recommend appropriate courses.

2.3. Algorithm

A student's performance model was developed using a supervised machine learning technique. The authors created a more precise prediction model using the student attributes by combining multiple linear regression and principal component analysis. The suggested methodology calls for several techniques to identify the most crucial variables, which are then used to create multiple linear regression models [15].

In a study [16], the aptitude test score, physical training time, and TNA module time are sufficient independent factors in the multiple regression model used to predict the student's performance. Multiple regression analyses were built to examine the association between each dependent variable and students' academic achievement. The time spent on physical training (X3), time spent on TNA modules, and the aptitude test score (X2) are independent variables that can be used to predict students' performance. The R2 values show that at least one of the predictor factors provides data for forecasting the student's performance. The rejection of the null hypothesis, according to their hypothesis, shows that the regression is not statistically significant, while the overall regression is. This suggests that the model may forecast the likelihood of attrition in specific programs.

The Multiple Regression can be written as**:**

$$\mathbf{y = b1x1 + b2x2 + \ldots + bnxn + c}$$

where;

y = dependent variable
x = independent variable
a = intercept
b = coefficient

Regressions involving numerous explanatory variables, both linear and nonlinear, fall under the category of multiple regression. Multiple regression includes various independent variables, whereas linear regression only considers one independent variable to affect the relationship's slope [17]. That is why *Dalan* uses multiple regression. It is frequently preferable since it should be employed when multiple independent variables determine the outcome of a single dependent variable which calls for more complex relationships to be considered. The variables used in *Dalan* are Entrance Exam and High School GPA as the independent variables, while the College Semestral GPA is the dependent variable.

2.4. Predictors

Currently, Ethiopian higher education institutions employ two factors to determine admission: high school GPA and results on university entrance tests. According to the study, it is crucial to look at the predictive validity of these two factors to ensure the accuracy of admission decisions. The study looks into how well high school GPAs and grades on university entrance exams predict college performance. Their work adds to the body of information and is significant regarding the predictive validity of high school GPA and university admission exam scores [18].

Another study [19] highlights the results of the exact value of the Standardized Test for English Proficiency as a requirement for admission for estimating students' chances of academic achievement. The study's findings revealed a significant relationship between students' test scores and their GPAs in their first year of college.

Regression correlation was employed to determine the predictive value of the entrance test results [20]. The outcomes showed that the admission exam score significantly predicted academic achievement. The study [20] intends to ascertain the correlation between college-level students' admission exam results and their grade-weighted average academic performance. The predictive value of the admission test to the student's academic success was calculated using linear regression [20]. The results of another study [21] demonstrated that student prior knowledge, as assessed by entrance exams and pre-entry grades in the proposed model, are significant predictors of students' academic performance in their first year of high school. Therefore, it is a valid tool for choosing the best and most dedicated applicants for admission.

Admissions test results significantly impact students' academic achievement and contribute to dropout [22]. However, another study [23] found that College Entrance Admission (CEA) did not appear to accomplish its intended goals. Its contribution to predicting first-year CGPA should be significantly more than what at least other predictor variables do because it is the only predictor variable through which the final teacher's education college admission decision was made.

Colleges generally use test results to assign students to developmental education [24]. Research, however, indicates that this strategy may lead to the misplacement of kids who may have excelled in college-level education. Instead, the opportunity to improve access to college-level coursework for truly equipped students to do well in those courses exists when high school GPAs are used in the placement process.

A study [25] also stated the importance of HSGPA in predicting students' performance. High School Grade Point Average (HSGPA) plays a significant role in student academic success in higher education. High school academic performance is a foundation for their performance in higher education. Predictors such as GPA or a student's standing in a class are crucial to understanding academic performance [25]. Another study [26] claims that the high school grade point average-based admissions procedure is legitimate due to the strong correlation between it and the academic success of dentistry students who graduated from the study. According to a study [27], HSGPAs outperform ACT scores as indicators of college preparedness across high schools. The study also stated that HSGPAs are strongly related to eventual college completion.

The abovementioned literature and studies support the idea of using Entrance Exam results and HSGPA as predictors in predicting the academic performance of the CITE freshmen students and will be used as the basis in the course recommendation of *Dalan.* The presented studies also support the statement that a significant relationship exists between Entrance Exam results and High School GPA to the College Semestral GPA.

3. METHODS

The proponents used the ex post facto method or after-the-fact research. The data used in this study were from the total *n* or population of the freshmen students enrolled in the CITE department from S.Y. 2013 – 2014 to S.Y. 2015 – 2016. The information and records were obtained from the NDMC Guidance Office and Registrar's Office. The data included the Entrance Exam (EE) results, High School Grade Point Average (HSGPA), and College Semestral Grade Point Average (CSGPA). The data were extracted directly from the files of 123 students. The data collected were organized to form the dataset of the study. 90% were treated as training data, while 10% were treated as test data.

Furthermore, the existence and strength of a relationship between two or more quantifiable variables were assessed using the correlation method. A correlation coefficient is used in correlational design to measure the strength of the relationship between two variables [28]. This

determined the relationship between the predictors and variables. Specifically, the correlation method measured the relationship between HSGPA, EE, and CSGPA.

Dalan was developed using VB.Net and SQL Management Studio for database management, where all the data was stored. Using Multiple Regression analysis, the test data were analyzed to develop a formula to calculate the predicted CSGPA of freshmen CITE students. Predicted CSGPA will serve as the basis for course recommendation. The questionnaire for Dalan's functionalities (efficiency, convenience, and accuracy) was administered to show its effectiveness in recommending courses for the tool.

4. RESULTS

4.1. Data Set

The data set of the study was composed of High School Grade Point Average (HSGPA), Entrance Exam (EE) results, and College Semestral Grade Point Average (CSGPA).

Table 1. Performance of CITE Department Students

Predictors	**Mean**	**Standard Deviation**
CSGPA	81.025	6.276
EE	21.479	19.907
HSGPA	83.524	3.043

Table 1 presents the Performance of CITE Department Students with n = 123 after computation. The table shows that the CITE Department's CSGPA mean 81.025 with a Standard Deviation of 6.276. For EE, the mean is 21.479, with a Standard Deviation of 19.907. Lastly, HSGPA's mean is 83.524, with a Standard Deviation of 3.043.

Table 2. Relationship between the Variables

Variable	**CSGPA**		
	r-value	p-value	Decision
EE	0.386	0.000	Reject H0
HSGPA	0.541	0.000	Reject H0

Table 2 presents the result of determining the relation of the predictors: EE and HSGPA to CSGPA. The proponents used Microsoft Excel to determine the strength of the relationship between EE and the CSGPA and HSGPA and the CSGPA.

Pearson's R correlation was used to determine the relationship between EE and HSGPA to CSGPA. The table shows that the r-value of EE to CSGPA is 0.386; it shows a significant relationship between EE and CSGPA. Likewise, HSGPA to CSGPA, with an r-value of 0.541, shows a significant relationship between the variables.

Table 2 also presents the p-value for EE to CSGPA, which is 0.000 and is less than 0.01. This means that the relationship between EE and CSGPA is Highly Significant. Likewise, HSGPA and CSGPA showed a p-value of 0.000, which means that the relationship is also highly significant

Table 3. Model Summary

Multiple R	R Square	Adjusted R Square	Standard Error
0.573	0.328	0.317	5.207

As manifested in Table 3, 32.80% of the variation is the dependent variable, the CSGPA accounted for the variations in the independent variables, EE and HSGPA, and the rest, 67.20%, is unexplained. The coefficient of non-determination value is found by subtracting the coefficient of determination from 1.

Although the mean is not utilized, the standard error is equivalent to the standard deviation. Simply put, it is the square root of the unaccounted-for variation, which is the variation resulting from the discrepancy between the observed and the anticipated values divided by n-2. So, the closer the observed values are to the predicted values, the smaller the standard error of the estimate will be. The lower the standard error of the estimate, the better the predictive model.

Table 4. ANOVA

	df	Sums of Square	MS	F	p-value
Regression	2	1590.993	795.497	29.340	.000b
Residual	120	3253.592	27.113		
Total	122	4844.585			

Table 4 reveals the ANOVA table, which manifested a p-value less than 0.01. This implies that the model is considered appropriate or a very good model to predict CSGPA via HSGPA and EE.

Table 5. Coefficients

Model	Coefficients	Standard Error	t Stat	p-value
Constant	0.309	13.835	0.0223	0.982
EE	0.064	0.0257	2.504	0.014
HSGPA	0.950	0.168	5.651	0.000

The data in Table 5 presents the coefficients of the regression equation. The predictor EE manifested a p-value of 0.014 and an HSGPA of 0.000, both highly significant in predicting CSGPA. Below is the developed predictive model based on the coefficients of the regression equation

Dalan Predictive Model

$$\mathbf{Y = 0.309 + 0.064\ X1 + 0.950\ X2}$$

where:

Y = College Semestral Grade Point Average (CSGPA)
X1 = Entrance Exam (EE) Results
X2 = High School Grade Point Average (HSGPA)

Example: If the Entrance Exam is 88, High School GPA is 75, expected CSGPA is

$Y = 0.309 + 0.064\ (88) + 0.950\ (75)$
$Y = 0.309 + 5.632 + 75.95$
$Y = 81.891$

4.2. Survey Analysis

The survey analysis for the effectiveness of *Dalan* was conducted on five (5) respondents from the Guidance Office, five (5) respondents from the Registrar's Office, ten (10) CITE faculty members and 100 students. 120 respondents were surveyed to identify the tool's effectiveness in terms of efficiency, convenience, and accuracy. The rating was scaled:

1 - Strongly disagree (SD),
2 - Disagree (D),
3 - Agree (A), and
4 - Strongly Agree (SA).

Table 6. Efficiency of Dalan

FUNCTIONALITIES	Rating				
	1	2	3	4	Mean
EFFICIENCY					
The tool can launch and terminate without error.	0	12	23	85	3.61
The tool helps the office to recommend a course.	0	0	34	86	3.72
The tool is efficient to use in recommending courses.	0	0	27	93	3.78
The functions are easy to remember.	0	7	25	88	3.68
The functions are working efficiently by using the search feature.	0	16	13	91	3.63
The tool is useful in finding the student's data from the table.	0	0	13	107	3.89
The tool can add new data of the students.	0	0	23	97	3.81
The tool can refresh the data from the table.	0	0	13	107	3.89
TOTAL MEAN					3.75

Table 6 shows the survey analysis for the Efficiency of the *Dalan*. The survey shows an outstanding total mean of 3.75 which means that the tool is efficient in recommending a course according to the 120 respondents.

Table 7. Convenience of Dalan

FUNCTIONALITIES	Rating				
	1	2	3	4	Mean
CONVENIENCE					
The tool is easy to use.	0	0	21	99	3.83
The tool is easy to remember.	0	1	18	101	3.83
The tool can edit and update student information in case of any changes.	0	0	13	107	3.89
The tool is easy to learn and manipulate.	0	0	27	93	3.78
The tool can store multiple data without limit.	0	0	19	101	3.84
The tool serves as another platform for recommending courses.	0	5	18	97	3.77
The tool is flexible and allows the user to access its contents.	0	6	39	75	3.58
The tool minimizes workload.	0	0	15	105	3.88
The tool can work without an internet connection.	0	0	0	120	4.00
TOTAL MEAN					3.82

Table 7 shows the survey analysis for the Convenience of the *Dalan*. The survey shows a total mean of 3.82, which shows that the respondents find the tool convenient in course recommendations.

Table 8. Accuracy of Dalan

FUNCTIONALITIES	Rating				
	1	2	3	4	Mean
ACCURACY					
The tool displays recommended courses based on the predicted GPA.	1	13	20	86	3.59
The tool calculates a predictive score from the analyzed data of the SHS GPA and Entrance Exam Result.	0	0	24	96	3.80
The tool saves the student information and predictive score in the database without duplication.	0	7	19	94	3.73
The tool displays ECE/CpE, BSCS, BSIT, and BSIS if the predicted GPA is greater than or equal to 85, which is based on the admission policy of the CITE department.	0	0	0	120	4.00
The tool displays BSCS, BSIT, and BSIS if the predicted GPA is greater than or equal to 82, which is based on the admission policy of the CITE department.	0	0	0	120	4.00
The tool displays BSIT and BSIS if the predicted GPA is less than or equal to 81, which is based on the admission policy of the CITE department.	0	0	0	120	4.00
TOTAL MEAN					3.85

Table 8 shows the survey analysis for the Accuracy of the *Dalan*. The survey shows a total mean of 3.85, which shows that the respondents find the tool accurate in recommending a course based on the data sets given.

5. DISCUSSION

The College of Information Technology and Engineering data sets have shown that the Entrance Exam (EE) result has a mean of 21.479, with a standard deviation of 19.907. The High School Grade Point Average (HSGPA) averages 83.524 and a standard deviation of 3.043, while College Semestral Grade Point Average (CSGPA) has a mean of 81.025 and a standard deviation of 6.276.
The result of the study presented a p-value of 0.000 for EE and CSGPA, which implies that the relationship between the two variables is highly significant since the p-value is less than 0.01. Likewise, the HSGPA and CSGPA have presented a p-value equal to 0.000, which is less than 0.01, which means that the relationship is also highly significant. Both predictors are highly significant, meaning any changes to the predictors significantly affect the predicted CSGPA. Therefore, the greater the rating of incoming CITE freshmen students in their HSGPA and EE, the higher their predicted CSGPA will be in their first semester, which will also affect the accuracy of the recommended course by *Dalan.*

The study's results affirmed by several researchers that HSGPA and EE are valid predictors for predicting the academic performance of a freshman student. A strong correlation exists between students' test grades and their first-year college GPAs [18]. Another study [23] also claims that using the High School GPA in the placement process could increase access to college-level coursework.

The proponents developed a predictive model **Y = 0.309 + 0.064 X1 + 0.950 X2** after using multiple regression analysis in the extracted data of 123 CITE Students of the first semester of S.Y. 2013 – 2014 to S.Y. 2015 – 2016. Identifying the constant coefficient equal to 0.309, while the Entrance Exam (EE) results' coefficient is equal to 0.064, and High School Grade Point Average (HSGPA) coefficient equal to 0.950. To solve for the CSGPA, which is Y, the constant coefficient is added to the EE coefficient multiplied by the X1, which is the freshmen student's EE, added to the coefficient of HSGPA multiplied by the X2, which is the freshmen student's HSGPA.

6. CONCLUSION AND RECOMMENDATIONS

Based on the study's findings, it can be concluded that HSGPA and EE are highly significant to the CSGPA. Therefore, the higher the scores of HSGPA and EE, the higher the student's academic performance will be in CSGPA.

Predictive model **Y = 0.309 + 0.064 X1 + 0.950 X2** is considered appropriate for predicting the CSGPA by using HSGPA and EE as predictors.

Based on the findings, the proponents of the study would like to recommend the following:

1. The admission policy of the CITE Department should give more weight to the HSGPA and EE ratings because HSGPA and EE are highly significant and are valid predictors of student performance [19].
2. This study will serve as the springboard for the Guidance Office to have a tool that may assist them in the course recommendation for all college freshmen.
3. This study will serve as a basis for future research on predicting the academic performance of not just CITE freshmen students but also the whole NDMC or other Higher Education Institutions.

ACKNOWLEDGMENT

This work is supported by the College of Information Technology and Engineering, Notre Dame of Midsayap College

REFERENCES

[1] D. Prajwala, Data Mining and Recommender Systems, https://www.geeksforgeeks.org/data-mining-and-recommender-systems, 2021.
[2] A. Twin, What Is Data Mining? How It Works, Benefits, Techniques, and Examples, https://www.investopedia.com/terms/d/datamining.asp, 2021.
[3] I. Upadhyay, What is Data Mining? Working, Uses, and Advantages, https://www.jigsawacademy.com/blogs/data-science/what-is-data-mining, 2020.
[4] V. Thi-Hai-Yen, A Personalized Course Recommender System for Undergraduate Students, http://www.ijlt.org/index.php?m=content&c=index&a=show&catid=137&id=717, 2019.
[5] M. Amazona and A. Hernandez, Modelling Student Performance Using Data Mining Techniques: Inputs for Academic Program Development, https://www.researchgate.net/publication/334080637_Modelling_Student_Performance_Using_Data_Mining_Techniques_Inputs_for_Academic_Program_Development, 2019.
[6] H. Bydžovská, Course Enrollment Recommender System retrieved from https://eric.ed.gov/?id=ED592681, 2017.
[7] Binisaya. Dalan: Binisaya - Cebuano to English dictionary and thesaurus. http://www.binisaya.com/cebuano/dalan, 2021.
[8] Google Translate. https://translate.google.com/?sl=ceb&tl=en&text=dalan&op=translate, 2021.
[9] M. Alam, Multiple regression as a machine learning algorithm, https://towardsdatascience.com/multiple-regression-as-a-machine-learning-algorithm, 2020.
[10] J. Stanton, Galton, Pearson, and the Peas: A Brief History of Linear Regression for Statistics Instructors, https://www.tandfonline.com/doi/full/10.1080/10691898.2001.11910537, 2017.
[11] Y. Zhang, Y. Yue, R. An, J. Cui, H. Dai and X. Shang, Educational Data Mining Techniques for Student Performance Prediction: Method Review and Comparison Analysis, https://www.frontiersin.org/articles/10.3389/fpsyg.2021.698490/full, 2021.
[12] A. Saa, Educational Data Mining & Students' Performance Prediction, https://www.researchgate.net/publication/303869038_Educational_Data_Mining_Students'_Performance_Prediction, 2016.
[13] M. Natividad, B. Gerardo, R. Medina, A fuzzy-based career recommender system for senior high school students in K to 12 education, iopscience.iop.org/article/10.1088/1757-899X/482/1/012025/meta, 2019.
[14] S. Asadi, S. Jafari and Z. Shokrollahi, Developing a Course Recommender by Combining Clustering and Fuzzy Association Rules, https://www.researchgate.net/publication/327514808_Developing_a_Course_Recommender_by_Combining_Clustering_and_Fuzzy_Association_Rules, 2019.
[15] O. Aissaoui, Y. Alami, L. Oughdir, A. Dakkak, and Y. Allioui, A Multiple Linear Regression-Based Approach to Predict Student Performance, https://www.researchgate.net/publication/338360511_A_Multiple_Linear_Regression-Based_Approach_to_Predict_Student_Performance, 2020.
[16] W. Khan, S. Al Zubaidy, Prediction of Student Performance in Academic and Military Learning Environment: Use of Multiple Linear Regression Predictive Model and Hypothesis Testing, https://eric.ed.gov/?id=EJ1151836, 2017.
[17] A. Blokhin, Linear vs. Multiple Regression: What's the Difference?, https://www.investopedia.com/ask/answers/060315/what-difference-between-linear-regression-and-multiple-regression.asp, 2022.
[18] M. Tesfa, The validity of University Entrance Examination and High school Grade point average for predicting first year university students' academic performance, https://essay.utwente.nl/66652/1/Tesema20M.20-20S139725720-20masterscriptie.pdf, 2018.

[19] N. Alotaibi, The Predictive Ability of High School General Point Average, Standardized Test for English Proficiency, and Type of High School to Foresee the Academic Success of Saudi EFL Freshmen, https://files.eric.ed.gov/fulltext/EJ1311621.pdf, 2021.
[20] A. Montalbo, Y. Evangelista, M. Bernal, Admission Test as Predictor of Student Performance in Political Science and Psychology Students of Rizal Technological, University.https://oaji.net/articles/2017/1543-1536136817.pdf, 2018.
[21] Magnolia A. Laus, Admission Profiles as Predictors of Academic Performance, https://research.lpubatangas.edu.ph/wp-content/uploads/2022/02/APJMR-2021.9.1.05.pdf, 2020.
[22] A. Magbag, R. Raga Jr., Prediction of College Academic Performance of Senior High School Graduates Using Classification Techniques, http://www.ijstr.org/final-print/apr2020/Prediction-Of-College-Academic-Performance-Of-Senior-High-School-Graduates-Using-Classification-Techniques.pdf, 2020.
[23] S. Takele, Validity Strength of College Entrance Assessment Score and High School Academic Records in Predicting College Academic Performance, https://files.eric.ed.gov/fulltext/EJ1137552.pdf, 2017.
[24] R. Northwest, Study Finds High School Grades are a Strong Predictor of College Readiness for Recent Graduates Colleges typically use standardized exam scores to place students in developmental education, https://educationnorthwest.org/news/study-finds-high-school-grades-are-strong-predictor-college-readiness-recent-graduates, 2017.
[25] K. Al Hazaa, The effects of attendance and high school GPA on student performance in first-year undergraduate courses, https://www.tandfonline.com/doi/full/10.1080/2331186X.2021.1956857, 2020.
[26] A. Al-Asmar, The predictive value of high school grade point average to academic achievement and career satisfaction of dental graduates, https://bmcoralhealth.biomedcentral.com/articles/10.1186/s12903-021-01662-5, 2021.
[27] E. Allensworth, High School GPAs and ACT Scores as Predictors of College Completion: Examining Assumptions About Consistency Across High Schools, https://sci-hub.se/10.3102/0013189X20902110, 2020.
[28] Voxco, Correlational Research: Definition, Examples, and Methods, https://www.voxco.com/blog/correlational-research, 2021.

AUTHORS

Michaelangelo R. Serrano received his master's degree in Information Management at the University of Southern Mindanao at Kabacan, North Cotabato, Philippines, in 2012. He is currently the program head for BS in Computer Science and BS in Information Technology at the College of Information Technology and Engineering at Notre Dame of Midsayap College, Midsayap, Cotabato, Philippines

Nero L. Hontiveros received his bachelor's degree in Computer Science at Notre Dame of Midsayap College in 2013. He is currently studying for his master's in Information Technology at the School of Information Technology, Mapua University, Makati City, Philippines. He is also a faculty at the College of Information Technology and Engineering at Notre Dame of Midsayap College, Midsayap, Cotabato, Philippines.

EJ Ryle C. Mosquera received his bachelor's degree in Computer Science at Notre Dame of Midsayap College in 2022. He is currently teaching at the College of Information Technology at Notre Dame of Midsayap College, Midsayap, Cotabato, Philippines.

Riza Lenn L. Cariaga received her bachelor's degree in Computer Science at the College of Information Technology and Engineering at Notre Dame of Midsayap College, Midsayap, Cotabato, Philippines, in 2022.

Novannyza Bien D. Catulong received her bachelor's degree in Computer Science at the College of Information Technology and Engineering at Notre Dame of Midsayap College, Midsayap, Cotabato, Philippines, in 2022.