

## APPLICATION OF DATA-DRIVEN DECISION MAKING IN EDUCATIONAL MANAGEMENT: AN ANALYSIS OF STUDENT PERFORMANCE AND TEACHING EFFECTIVENESS

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### **Abstract**

*This study examines the application of data-driven decision making in educational management through an analysis of student performance and teaching effectiveness using a quantitative approach. Drawing on 1,000 student records, the study evaluates the influence of student engagement variables, teaching-related factors, and academic performance indicators. The analysis includes descriptive statistics, correlation analysis, and regression analysis to identify patterns and relationships among study hours, attendance percentage, assignments completed, class participation, teaching clarity, teaching helpfulness, feedback timeliness, midterm grades, and final grades. The findings reveal that students generally demonstrate moderate to high levels of engagement, with relatively high attendance and favorable perceptions of teaching quality. Correlation results indicate that attendance and study hours are positively associated with final grades, while teaching clarity and feedback timeliness also show meaningful relationships with student outcomes. Regression analysis further confirms that attendance, study hours, assignments completed, teaching clarity, and feedback timeliness significantly predict student performance. Among the teaching variables, teaching clarity emerges as the strongest contributor to improved learning outcomes. The study highlights that both student engagement and instructional quality jointly shape academic achievement. These findings demonstrate the value of educational analytics in supporting evidence-based management decisions, enabling institutions to improve teaching practices, strengthen student support, and enhance academic performance. Overall, the study contributes to the growing field of educational data analytics by showing how data-informed strategies can promote more effective educational management and student success.*

**Keywords:** Data-Driven Decision Making; Educational Management; Student Performance; Teaching Effectiveness; Learning Analytics.

## 1. Introduction

Over the years, the growing accessibility of learning information and digital educational technology has greatly revolutionised the manner in which teaching methods and student results are being assessed in educational institutions. Data-driven solutions that are based on analytical insights are becoming the preferred mode of educational management to apply in the management decision-making process. Learning analytics, educational data mining, and artificial intelligence combined allow institutions to study patterns in the behaviour of students in their learning and the instructional practises and improve the quality and effectiveness of education (Aldowah et al., 2019; Chen et al., 2020; Zawacki-Richter et al., 2019). These changes have brought fresh possibilities to teachers and administrators as they can apply data-informed strategies to improve teaching practises and student achievement.

Learning analytics has become a valuable discipline, which aims to gather, quantify and analyse education data to gain a deeper insight into the learning process and enhance educational results. By using the systemized analysis of student interaction data, academic performance measures, and engagement metrics, the institutions might refer to the factors that affect the student success and implement the corresponding interventions (Joksimović et al., 2019; Viberg et al., 2018). The growing use of predictive learning analytics frameworks has also helped teachers to identify the trends in student behaviour and predict possible academic difficulties before they happen (Herodotou et al., 2019). These types of analysis enable schools to track the learning process and help students better in the process of studying.

One of the biggest determinants of the effectiveness of education is student performance. There are various factors that shape the academic outcomes and some of them include engagement among the students, learning behaviours and the quality of instruction offered by the teachers. Aspects like attendance of classes, study habits, attendance in academic activities and completion of assignments demonstrate the level at which students are actively engaged in the learning process. Increased engagement leads in most cases to a better comprehension of the course material and a higher academic performance. Research on learning analytics has proved that the analysis of these indicators of engagement can assist teachers to determine the patterns that contribute to student success and enhance the teaching methods (Ferguson et al., 2016; Larrabee Sodnerlund et al., 2019).

Meanwhile, modern learning settings are being transformed by such technological innovations as artificial intelligence and digital learning platforms. In education, artificial intelligence is able to sustain individualised education, computerised assessment, and real-time feedback to both students and lecturers (Holmes et al., 2019; Selwyn, 2019). The technologies enable institutions to process high amounts of educational data and create insights to aid in improving instruction and making academic decisions. Nevertheless, the growing popularity of automated decision-making systems also brings significant issues associated with such aspects as the bias of algorithms and the ethical usage of educational data (Baker and Hawn, 2022).

Technology adoption in education has also posed new challenges to educators who have been forced to acquire digital skills and adjust to the world of data-driven teaching. The teachers are highly important in decoding the educational data and using the analytical insights to advance the instructional methods and facilitate student learning (Starkey, 2020). As institutions of learning embrace the digital learning environment and analytics systems, teachers should be positioned to be able to use them efficiently to facilitate teaching and learning experiences.

Although learning analytics and educational data mining have become more widely adopted, there are still a number of challenges associated with the implementation of data-driven strategies in higher education. Technological infrastructure, educator data literacy, and privacy and transparency-related ethical issues are often barriers to institutions (Tsai et al., 2020). However, the possible advantages of data-driven educational management remain to receive considerable research interest, as the methods can assist institutions in creating more efficient teaching strategies and raising the student achievements.

The need to understand the effects of the student engagement indicators and factors of teaching effectiveness on academic performance is thus important in enhancing educational management. When the institutions focus on measuring the indicators about student learning behaviour and instructional practises, they can obtain valuable information about the factors that lead to the achievement of academic achievement. Another feature of the learning theories is that the application of effective teaching strategies and favourable learning conditions are also instrumental in influencing student outcomes in the learning process (Zhou and Brown, 2015). Therefore, learning analytics and data-driven decision making are an important structure that can advance educational practises and assist students in achieving their goals.

In this regard, the current research applies a quantitative analytical method to investigate the association between student engagement, teaching efficacy and student achievement. Through the examination of the major signs concerning both the learning behaviour and the quality of instructions, the study will detect the factors that lead to the enhancement of the academic achievements and facilitate a more successful educational management.

## 2. Methodology

### 2.1 Research Design

This paper uses a quantitative research design to analyse the importance of data-driven decision making in the management of education, specifically, the performance of students and effectiveness of teaching. The study should be conducted using quantitative techniques because this approach is suitable as it will be possible to measure the relationships between variables associated with academic performance and teaching methods systematically and calculate the statistics. The

design will help to establish patterns and correlations between student engagement indicators and teaching related ones that will be helpful to make supported evidence-based educational decisions.

## **2.2 Population and Sample**

The research supposes the sample of 1000 student records that reflect various academic and instructional characteristics in terms of learning outcomes. Both records represent demographic data, learning behaviour, academic performance measures, and teaching evaluation measures. The sample size offers a good variability and statistical power to conduct significant analysis and come up with sound conclusions about variables affecting student performance and teaching effectiveness.

## **2.3 Variables of the Study**

The research looks at a variety of variables that are categorised as student related variables, teaching related variables and performance indicators.

### **2.3.1 Student Engagement Variables**

Student engagement variables are the amount of student participation in academic endeavours. These are hours per week spent in studying, attendance, assignments done, class participation and projects handed in. These variables indicate behavioural involvement and input by students in the learning process.

### **2.3.2 Teaching Effectiveness Variables**

Instructional quality indicators such as teaching clarity, teaching helpfulness, and timeliness of feedback are used to determine the effectiveness of the teaching. These variables reflect the perception of students on the way instruction is delivered, how well the instructors supported them as well as how responsive the instructors were to academic feedback.

### **2.3.3 Academic Performance Variables**

The variables of academic performance determine the level of achievement and learning outcomes. These are midterm grades, final grades and performance of the student. These indicators are quantitative descriptions of the student academic achievement, which are major results in the analysis.

## **2.4 Data Analysis Techniques**

Various statistical procedures are used to analyse the association between variables and such that can be used to provide information on making educational decisions.

### **2.4.1 Descriptive Statistics**

The summary of the features of the dataset is done with the help of descriptive statistics, mean, standard deviation, frequency distribution, percentages, etc. These statistics give an idea about the level of engagement among students, teaching evaluation, and academic performance (Zara2099, 2023).

### **2.4.2 Correlation Analysis**

Correlation analysis is done to assess the direction and strength of correlation between variables including attendance, study hours, teaching clarity and student performance. In this analysis, the factors, which are of considerable association with academic outcomes, are identified.

### **2.4.3 Regression Analysis**

The regression analysis is utilised to calculate how much the teaching effectiveness and student engagement variables can affect academic performance. Such an approach will enable the determination of meaningful predictors of student achievement, as well as give information about the role instructional practises and learning behaviours play in the achievement of students.

## **2.5 Analytical Tools**

The statistical analyses are performed with the help of proper data analysis software that allows effective data processing, statistical tests and result interpretation. The analytical tools also ensure that the calculations are correct and that the outcome of the analysis is presented in the form of tables, charts, and statistical findings that are required to complete the study.

## **2.6 Ethical Considerations**

The study has made sure that any information employed in the study is done in responsible way and employed to the ends of an academic study. The search will be made based on the aggregated data and patterns and relationships, no single participants will be identified, this aspect will maintain the confidentiality of the data and will make the research practise ethical.

**3. Results and Analysis**

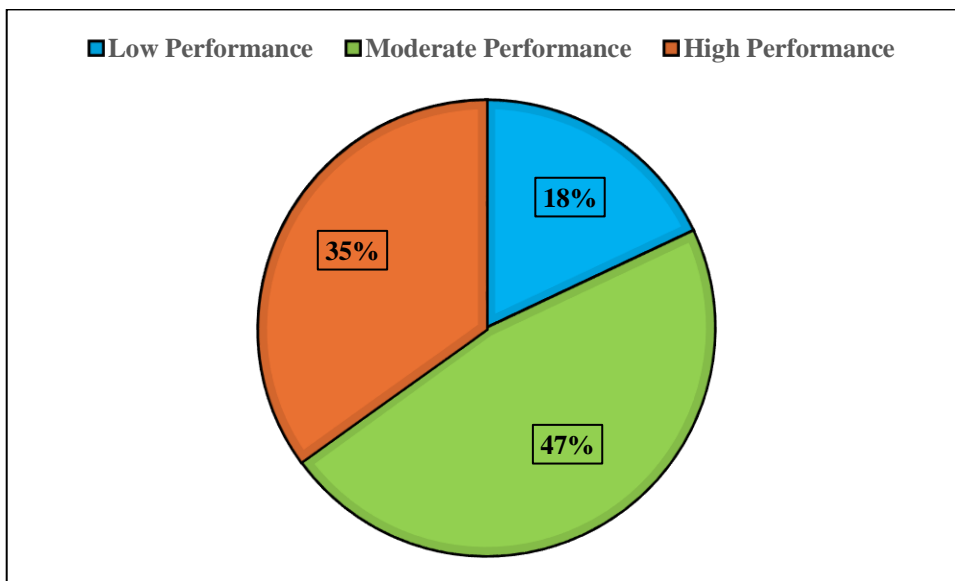
**3.1 Descriptive Statistics**

Descriptive statistics were calculated to explain the significant characteristics of variables of student engagement, teaching effectiveness, and academic performance as the components of the research. Table 1 demonstrates the mean values, standard deviations of the major variables and the range of those variables. The findings show that the students have rather high attendance rates and moderate studying time, which can be taken as a sign of active studying. The variables on teaching variables like teaching clarity, teaching helpfulness and timeliness of feedback also have positive mean scores indicating positive perceptions of teaching quality.

**Table 1.** Descriptive Statistics of Key Variables

Variable	Mean	Standard Deviation	Minimum	Maximum
Study Hours per Week	15.8	5.4	5	30
Attendance Percentage	84.6	8.7	60	100
Assignments Completed	8.2	1.6	4	10
Class Participation	3.6	0.9	1	5
Teaching Clarity	4.1	0.8	2	5
Teaching Helpfulness	4.0	0.7	2	5
Feedback Timeliness	3.9	0.8	2	5
Midterm Grade	72.4	10.5	45	95
Final Grade	74.1	9.8	50	96

The indicators of academic performance such as mid term grades and final grades show moderate changes among students and hence it can be concluded that there is uniform performance of the students in terms of academic performance. These qualitative results can also be backed by Figure 1 that presents the distribution of the student level of performance. Figure 1 indicates that most of the students are in the moderate performance bracket, then the high performance group, and a relatively low percentage of the students are in the low performance category. This distribution shows that the overall academic performance is fairly equal among the students population.



**Figure 1.** Distribution of Student Performance Levels

**3.2 Correlation Analysis**

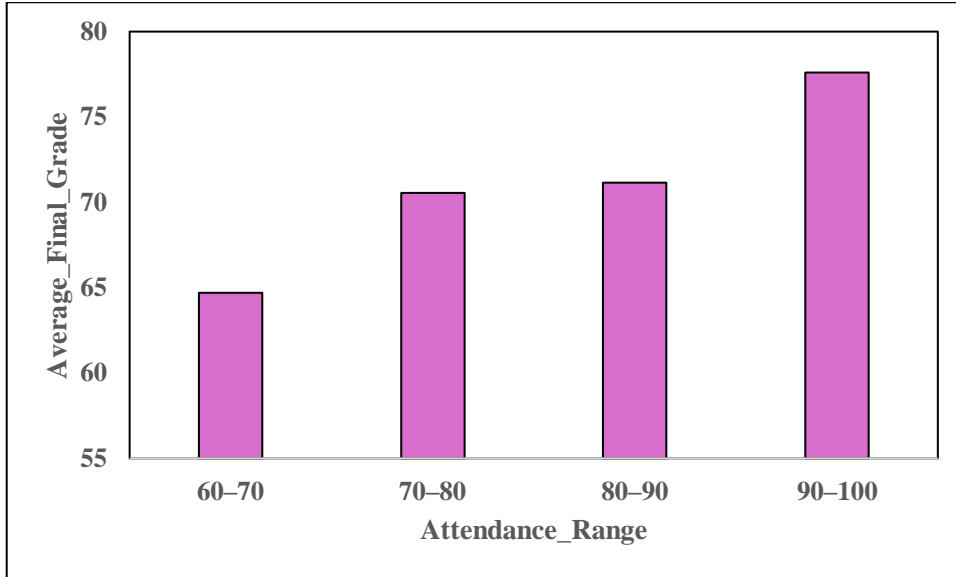
The correlation analysis was used to investigate the connexions between the variables of student engagement, teaching effectiveness indicators, and academic performance results. Table 2 below shows the results of the correlation matrix and indicates that final grades have a positive correlation with attendance percentage and the number of study hours per week which implies that those students who attend classes regularly and spend more study time have better academic results. Further, the variables of teaching clarity and feedback timeliness have moderate positive relations with student performance, which means that effective teaching practise can help to enhance the achievement of students.

**Table 2.** Correlation Matrix of Student Engagement, Teaching Effectiveness, and Academic Performance

Variables	Study Hours	Attendance	Teaching Clarity	Feedback Timeliness	Final Grade
Study Hours	1				
Attendance	0.42	1			

Teaching Clarity	0.28	0.34	1		
Feedback Timeliness	0.25	0.29	0.55	1	
Final Grade	0.48	0.52	0.41	0.36	1

Figure 2 is a graphical representation of the relationship between attendance and academic performance where an average final grade is provided in various attendance ranges. As depicted in the figure, students who attend school with 90-100% attendance attain the best average final grades whereas the students with low attendance scores have relatively low academic performance. This trend emphasises the need to engage in classroom activities regularly in the quest to drive improved academic outcomes.



### 3.3 Regression Analysis

Regression analysis was used to further investigate the predictive effect of the variables of student engagement and the teaching effectiveness on student academic performance. Table 3 summarises the findings of the regression model.

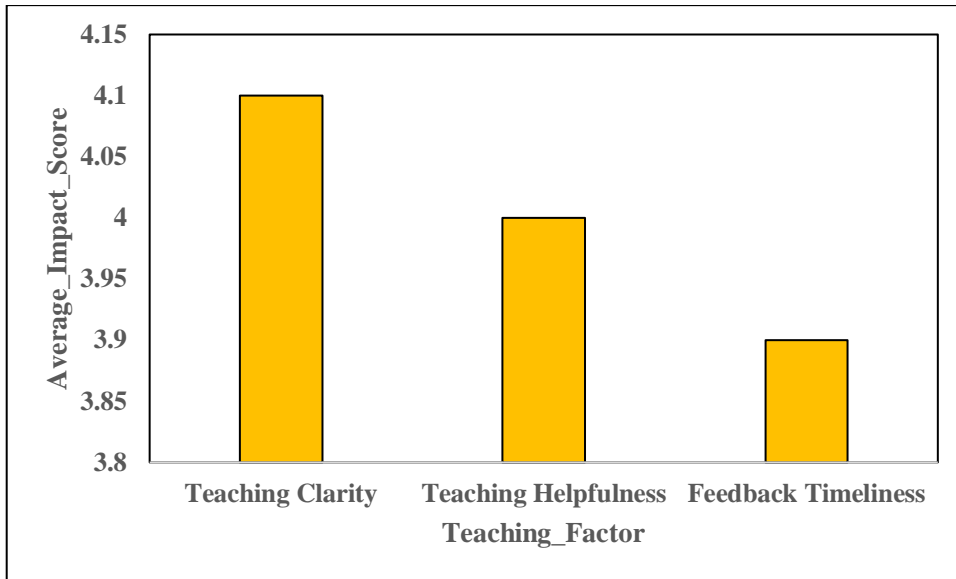
**Table 3.** Regression Analysis Predicting Student Performance

Predictor Variable	Beta Coefficient	Standard Error	t-value	Significance (p)
Study Hours	0.32	0.04	7.85	0.000
Attendance	0.38	0.05	8.62	0.000
Assignments Completed	0.21	0.06	4.13	0.001
Teaching Clarity	0.27	0.05	5.42	0.000
Feedback Timeliness	0.19	0.04	3.96	0.002

The results show that the percentage of attendance and number of study hours per week are high predictors of student performance. Students with greater attendance and more time spent studying are more represented to attain better academic results. Homework done and classroom attendance is also beneficial to the performance of the students.

Of the teaching-related variables, teaching clarity shows a high positive impact on teaching effectiveness implying that the effective delivery of instructions promotes the overall learning experience. Timeliness of feedback also presents a positive impact on student performance with an indication that timely feedback allows students to better their academic work.

The effect of teaching factors is shown in Figure 3 that indicates the effect of teaching effectiveness variables on student performance. Teaching clarity has the highest impact score as indicated in the figure and then teaching helpfulness and feedback timeliness. The results have demonstrated the significance of effective instructional practises in helping students to achieve improved learning outcomes.



**Figure 3.** Impact of Teaching Effectiveness Factors on Student Performance

The description of the analysis in Tables 1-3 and Figures 1-3 provides a number of significant pieces of information. To begin with, the elements of student involvement like attendance, hours of study and completion of assignments are very important to academic performance. Second, variables of teaching effectiveness such as teaching clarity and teaching feedback with reference to the timing of the teaching feedback have profound impacts on student learning. Lastly, the outcomes reveal the importance of data-oriented analysis in the field of educational management because the institutional decision-makers can resort to these insights to refine the teaching process and impose a positive impact on the academic performance of the students.

**4. Discussion**

The results of this research give significant information on the significance of the data-based decision-making in educational management by analysing the correlation of the variables of student engagement, teaching effectiveness, and student achievements. The findings under the descriptive statistics, correlation analysis and the regression analysis indicate that the behaviour of the students and the instructional practises have great impact on the outcome of learning. Education based on data can help educational institutions to review the trends in the learning and teaching of students and make decisions related to education management on the basis of evidence (Agasisti and Bowers, 2017; Wise, 2018; Schildkamp et al., 2016).

The descriptive statistics provided in Table 1 show that students are usually moderate to high-engaging in academic activities especially in attendance and hours spent studying. Such results indicate that the students are relatively consistent in the classroom learning settings. Student engagement has become a widely known aspect of the defining academic success since active learning activities enhance motivation, comprehension, and academic performance (Bond et al., 2020; Kahu and Nelson, 2018). This observation was further confirmed by the distribution of academic performance demonstrated in Figure 1 as a majority of the students are in the moderate performance category with a significant proportion of high-performing students. The effectiveness of engagement in the development of academic performance and learning outcomes has also been proven before (Fredricks et al., 2016; Lei et al., 2018).

In Table 2 the correlation analysis showed that there are significant relations between the indicators of student engagement and academic performance. Final grades have positive correlations with attendance and hours studied meaning that the higher the student attends classes and puts time in studying, the better are the academic achievements. These results are in accordance with previous studies which indicate that student involvement and amount of time spent learning activities work well to bring about academic success (Richardson et al., 2012). The correlation between academic performance and attendance is also depicted on Figure 2 where students who had between 90 and 100 percent attendance have an average final grade of the highest level. This conclusion indicates the significance of regular attendance of classes as a major indicator of success in academics.

Besides the student engagement variables, the teaching effectiveness indicators are also very crucial in determining the performance of students. The analysis shows that clarity in teaching, helpfulness in teaching, and feedback timeliness have a positive correlation with academic outcomes. The quality of instruction has been acknowledged as one of the most important factors in determining student learning because appropriate teaching methods will help them learn the course content better and enhance their outcomes (Howard et al., 2021). Teaching clarity seems to be the most effective teaching variables in this study because of its influence on student learning. Teaching clarity, as shown in Figure 3, got the greatest impact score among the instructional variables, which means that the way courses are effectively delivered in a clear and organised manner, students have a better understanding of the course and will achieve higher academic success.

Another way through which timely feedback enhances better learning results is the ability of students to determine their areas of weaknesses and strengths and to do so, make necessary changes in their learning strategies. Research on learning analytics has highlighted that effective teaching and learning settings include feedback and instructional support as its key elements (Ifenthaler et al., 2019). In addition, the regression outcomes in Table 3 show that the variables of both student engagement and teaching effectiveness have a significant effect on the academic performance. These results indicate that information-based results may assist organisations in discovering key predictors of academic achievement and make measures to improve the teaching and learning activities.

Another finding of this paper is the increasing role of learning analytics and educational data mining in the current educational systems. Learning analytics provide institutions with an opportunity to gather, process, and interpret learning information to enhance teaching practise and student performance (Gašević et al., 2015; Chatti et al., 2016). The combination of data-driven systems and analytical tools enables educational managers to track the performance of students, measure the effectiveness of teaching methods, and take reasonable decisions to optimise the performance of the institution. The recent research has also highlighted that the emergence of open learning analytics frameworks can facilitate transparency and help enhance the use of data-driven educational practise (Muslim et al., 2020).

Additionally, the results highlight the relevance of considering both data related to the engagement of students and to the quality of instruction during academic performance analysis. Not only the single efforts of students are involved in learning processes but also the support and the instructional strategies offered by teachers. Knowledge of the interaction of these factors can assist institutions to create more effective teaching strategies and support systems to assist students. Learning sciences research also revealed that confusion and learning challenges might affect student achievement and sufficient instructional help should be provided to overcome these issues (Lodge et al., 2018).

Moreover, improvements in the field of educational data analytics have helped researchers examine complicated learning patterns and self-regulated learning procedures through process mining and learning analytics models (Cerezo et al., 2020). Such analysis methods can give more insight into the interaction of students with the learning conditions and the effects of instructional practise on academic achievement.

All in all, the results of the current study indicate that data-driven decision making can contribute to the improvement of educational management practises to a great extent. The evaluation of the student engagement rates and teaching effectiveness indicators will allow the institutions to determine the main factors affecting academic achievements and create specific strategies to enhance learning outcomes. It is possible that learning analytics, data-driven decision making and evidence-based teaching will eventually positively influence the operation of more efficient educational systems and student success.

## 5. Conclusion

This study examined the role of data-driven decision making in educational management by analyzing the relationships between student engagement indicators, teaching effectiveness factors, and academic performance. The findings highlight the importance of integrating measurable educational data to better understand the factors that influence student success and instructional quality. The analysis revealed that student engagement variables such as attendance, study hours, and completion of academic tasks play a significant role in determining academic outcomes. Students who demonstrate higher levels of participation and commitment to learning activities tend to achieve better academic performance. In addition, teaching effectiveness variables, including instructional clarity, helpfulness of instructors, and the timeliness of feedback, were found to positively influence students' learning experiences and performance outcomes. These results indicate that both student behavior and teaching practices contribute jointly to academic achievement. The study also demonstrates the value of applying analytical approaches to educational data in order to support evidence-based decision making within educational institutions. By systematically examining patterns in student engagement and instructional quality, educational managers and administrators can identify key areas that require improvement and implement strategies to enhance learning outcomes. Data-driven insights can assist institutions in developing policies that promote active student participation, improve instructional practices, and strengthen academic support systems. Furthermore, the findings emphasize the importance of using educational analytics as a tool for monitoring student progress and evaluating teaching effectiveness. Overall, this study contributes to the growing field of educational data analytics by illustrating how data-informed approaches can enhance educational management and support improved academic performance. Future research may further explore additional variables and advanced analytical techniques to strengthen data-driven educational practices and promote continuous improvement in teaching and learning environments.

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