Java-Based System for Personalized Study Tracking and Performance Prediction

A Learning Analytics Approach to Monitoring Study Patterns and Academic Performance

Mr. Nikhil Kailas Gambhir

Prof. Swaraj Sanjay Malve

Assistant Professor, Department of Master of Computer Application,
JCEI's Jaihind Institute of Management and Research, Vadgaon Sahani
Email: nikhilgambhir793@gmail.com
Swarajmalve79@gmail.com

Abstract - Students often find it difficult to maintain consistent study habits and evaluate their learning progress over time. Manual study records do not provide sufficient information about subject-wise effort, study consistency, or possible future performance. This research proposes a Java-Based System for Personalized Study Tracking and Performance Prediction that records and analyzes students' daily study activities. The proposed system is developed using Java and Java Swing, with CSV-based storage for maintaining study records. It collects information such as study date, subject, study duration, and study description, and uses this data to generate date-wise and subject-wise summaries. The system further analyzes historical study behavior, including study duration, active study days, subject-wise effort, and consistency, to generate a performance estimate. A weighted scoring approach is used to provide personalized performance guidance based on the student's previous study patterns. The proposed system provides a lightweight and low-cost solution for students to monitor their learning activities without requiring a complex database environment. Experimental evaluation on 38 study-log records covering 35 active study days showed a total study duration of 148 hours across five subjects, with an estimated performance score of 86.80 out of 100 (High level). The results indicate that structured study tracking and historical analysis can help students identify their study patterns and areas requiring additional attention. The proposed framework can be further enhanced using machine learning algorithms, larger datasets, graphical dashboards, and web or mobile interfaces.

Key Words: Java, Personalized Learning, Study Tracker, Performance Prediction, Java Swing, CSV, Learning Analytics.

1. INTRODUCTION

Academic performance is influenced not only by a student's learning ability but also by study duration, consistency, subject-wise effort, and the ability to monitor learning activities. Students often maintain their study information manually in notebooks or unstructured files, making it difficult to identify long-term study patterns, measure consistency, and understand the distribution of study time among different subjects.

A personalized study tracking system can convert daily study activities into structured information and provide meaningful insights into a student's learning behavior. By maintaining records of study date, subject, duration, and study description, students can monitor their progress and identify areas that require additional attention.

Java provides a suitable platform for developing such a system because it supports object-oriented programming, graphical user interface development, file handling, and collection frameworks. The proposed system uses Java and Java Swing to provide an interactive desktop application, while CSV-based storage is used to maintain study records without requiring a complex database environment.

The proposed system goes beyond basic study record management by analyzing historical study data. Study duration, active study days, subject-wise effort, and study consistency are considered to generate useful performance indicators. Based on these historical patterns, the system provides an estimated future performance level and personalized guidance to the student.

The main purpose of this research is to develop a simple, low-cost, and practical study tracking system that helps students understand their learning patterns and improve their study consistency. The proposed framework can also be extended in the future by integrating machine learning algorithms, larger datasets, graphical dashboards, database storage, and web or mobile interfaces.

1.1 Problem Statement

Students often find it difficult to track their daily study activities and understand their study consistency and subject-wise progress. Traditional manual methods do not provide automatic analysis or performance prediction. Therefore, a simple Java-based system is required to record study data, analyze learning patterns, identify weak areas, and provide an estimated future performance.

1.2 Objectives

- To develop a Java-based personalized study tracking system.
- To record students' date, subject, study duration, and study description.
- To generate date-wise and subject-wise study summaries.
- To analyze historical study data and study consistency.
- To identify subjects or areas that require additional study effort.
- To estimate future performance based on previous study patterns.
- To provide a simple and low-cost solution for personal academic monitoring.

1.3 Contributions

- Developed a modular Java Swing application for personalized study tracking.
- Implemented CSV-based storage for maintaining study records.
- Used Java Collections for efficient data organization and retrieval.
- Added date-wise and subject-wise analysis to understand study patterns.
- Developed a performance prediction component based on historical study behavior.
- Provided a framework that can be extended with Machine Learning, database, web, or mobile technologies.

2. LITERATURE REVIEW

Educational Data Mining (EDM) and Learning Analytics are widely used to understand student learning behavior and academic progress [1], [3]. Previous research has shown that student-related data can be collected and analyzed to identify learning patterns, monitor progress, and support academic improvement [2].

Traditional academic monitoring mainly depends on examination marks, attendance, and teacher observations. However, these methods may not fully capture a student's daily study behavior. Study tracking systems can help students record their learning activities and understand their study patterns.

Previous studies have also explored the use of historical learning data for predicting student performance [1], [3]. Factors such as study activities, learning consistency, and previous academic data can provide useful information for performance analysis.

However, many existing systems require large datasets, complex algorithms, or institutional-level data. Therefore, there is a need for a simple and personalized system that allows students to track their daily study activities and analyze their own historical data.

The proposed research addresses this gap by combining study tracking, subject-wise analysis, study consistency, and performance prediction in a Java-based desktop application.

Table 1: Comparison of Existing Approaches and Proposed System

Approach	Strengths	Limitations
Traditional Manual Tracking	Simple, easy to maintain.	Time-consuming, no automatic analysis.
Study Planning Applications	Helps in scheduling and task management	Limited performance analysis
Learning Analytics	Analyzes student learning behavior	May require large datasets and complex system.
Educational Data Mining	Identifies learning patterns and performance factors	Requires suitable educational data
Proposed System	Personalized tracking, subject-wise analysis, consistency measurement and performance prediction	Prediction depends on historical study

3. METHODOLOGY

3.1 System Architecture

The proposed system is organized into five main layers: Study Log Input Layer, Storage Layer, Analysis Layer, Prediction Layer, and User Interface Layer. The Study Log Input Layer collects the student's study date, subject, study duration, and description. The Storage Layer maintains the collected records in a CSV file. The Analysis Layer processes the stored records and generates date-wise, subject-wise, and overall study statistics. The Prediction Layer analyzes historical study behavior, including study duration and consistency, to estimate future performance. The User Interface Layer, developed using Java Swing, provides an interactive interface through which students can enter, view, analyze, and export their study records, as shown in Fig. 1.

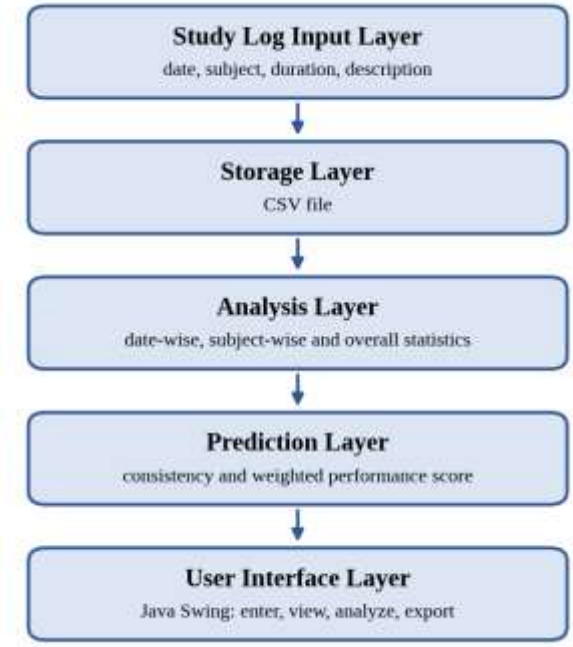


Fig. 1: Architecture of the proposed system

3.2 Analysis Techniques

The proposed system uses simple data analysis techniques to identify variations in a student's study behavior [6]. The system analyzes study duration, study consistency, active study days, and subject-wise study time. Threshold-based analysis is used to identify subjects requiring additional attention: a subject is flagged when its total study time is below the average subject-wise study time, which is 29.6 hours (148 hours / 5 subjects) for the present dataset. Average study duration is calculated to compare the student's study effort across different days and subjects. Subject-wise analysis helps identify subjects receiving less study time. These indicators are combined to provide personalized study guidance and support the performance prediction process.

3.3 Dataset

The dataset used for the experimental evaluation consists of 38 study-log records recorded using the proposed Java-based study tracking system. The records cover 35 active study days and contain the study date, subject, study duration, and study description. The dataset includes five subjects: Java, C, C++, SQL, and DSA. The total recorded study duration is 148 hours, with an average study duration of 3.89 hours per study session. The collected records are stored in CSV format and are analyzed to calculate total study duration, average study duration, active study days, and subject-wise study effort. The average daily study duration is 4.23 hours (148 hours / 35 active study days). The dataset represents the study activity of a single student over a 35-day period.

3.4 Evaluation Parameters

The proposed system is evaluated using study-related indicators derived from the collected historical records. The evaluation considers total study duration, average study duration, active study days, subject-wise study distribution, and study consistency. Total study duration represents the cumulative time spent on recorded study sessions, while average study duration represents the average time spent per study session. Active study days indicate the number of distinct dates on which study activity was recorded. Subject-wise analysis measures the distribution of study time among different subjects. Study consistency is used to assess the regularity of study activity over the selected period.

Study consistency is calculated as: Consistency (%) = (Active Study Days / Total Days in the Selected Period) × 100. For the present dataset, the selected period is the 35-day study period; therefore, Consistency (%) = (35 / 35) × 100 = 100%.

The performance estimation component uses these indicators within a weighted scoring approach to generate an estimated performance level.

The estimated performance score is calculated as: Performance Score = (w1 × Duration Score) + (w2 × Consistency Score) + (w3 × Subject Balance Score), where w1 + w2 + w3 = 1. In this study, the weights were set to w1 = 0.40, w2 = 0.40, and w3 = 0.20, giving higher and equal importance to study duration and consistency, which directly reflect study effort and regularity, and a lower weight to subject balance as a supporting indicator.

Each component is normalized to a 0–100 scale. Duration Score = min(100, (Average Daily Study Duration / Target Daily Duration) × 100), where the target daily duration is set to 5 hours. Consistency Score is equal to the study consistency percentage. Subject Balance Score = (Lowest Subject Study Time / Highest Subject Study Time) × 100.

For the present dataset, Duration Score = ((148 / 35) / 5) × 100 = 84.57, Consistency Score = 100, and Subject Balance Score = (24 / 37) × 100 = 64.86. Therefore, Performance Score = (0.40 × 84.57) + (0.40 × 100) + (0.20 × 64.86) = 33.83 + 40.00 + 12.97 = 86.80 out of 100.

The score is mapped to a performance level as follows: 80–100 as High, 60–79.99 as Moderate, and below 60 as Low. Hence, the estimated performance level for the present dataset is High.

Since the current implementation does not use independently measured academic ground-truth values, prediction accuracy is not reported using Mean Absolute Error. Future versions incorporating examination marks or other verified academic outcomes can evaluate prediction accuracy using Mean Absolute Error or other suitable prediction metrics [7].

3.5 Experimental Setup

The proposed system was implemented using Java as the primary programming language [4]. Java Swing was used to develop the graphical user interface [5], while CSV files were used for storing study-log data. The system was developed and tested using an Integrated Development Environment (IDE). Java collections such as ArrayList and TreeMap were used for data management and analysis. The experiment was conducted using study records containing date, subject, study duration, and description. The collected data was analyzed to calculate study consistency, average study duration, and subject-wise study patterns. These historical study patterns were further used by the prediction component to estimate future performance.

4. RESULTS

The developed Java-based personalized study tracking system successfully recorded study activities and stored the collected records in CSV format. The system generated date-wise and subject-wise summaries from the recorded study logs. The analysis component calculated total study duration, average study duration, active study days, subject-wise study distribution, and study consistency.

The experimental evaluation of the study-log dataset shows that the system recorded 38 study sessions across 35 active study days. The total recorded study duration was 148 hours, while the average study duration was 3.89 hours per session. Subject-wise analysis showed that Java received the highest study time with 37 hours, followed by C with 30.5 hours, DSA with 29.5 hours, C++ with 27 hours, and SQL with 24 hours. These results demonstrate that the proposed system can organize study records and identify differences in study effort across subjects. Table 2 summarizes the results obtained from the study-log dataset.

Table 2: Results obtained from the study-log dataset and performance estimation

Analysis Parameter	Result Obtained
Number of Study Records	38
Active Study Days	35
Total Study Duration	148 hours
Average Study Duration	3.89 hours
Highest Study-Time Subject	Java
Java Study Time	37 hours
Lowest Study-Time Subject	SQL
SQL Study Time	24 hours
Average Daily Study Duration	4.23 hours
Study Consistency	100%
Duration Score	84.57
Subject Balance Score	64.86
Estimated Performance Score	86.80 / 100
Performance Level	High

Using the weighted scoring approach described in Section 3.4, the system generated an estimated performance score of 86.80 out of 100 (Duration Score = 84.57, Consistency Score = 100, Subject Balance Score = 64.86), corresponding to a High performance level. Study consistency was calculated as 100%

over the 35-day study period. The subject-wise distribution of study time is shown in Fig. 2.

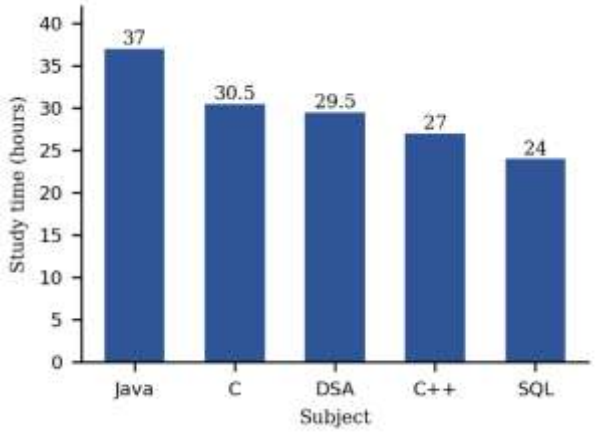


Fig. 2: Subject-wise study time (hours)

The results indicate that the system can effectively monitor study activities and generate useful insights from historical study data. Subject-wise analysis helps identify areas receiving less study time, while consistency analysis provides an understanding of regular and irregular study patterns. These results are further used by the prediction component to provide personalized performance guidance.

5. DISCUSSION

The results indicate that the proposed personalized study tracking system can effectively support students in monitoring and analyzing their study activities. The system provides useful information such as total study duration, average study duration, active study days, subject-wise study time, and study consistency. These indicators help students understand their study habits and identify subjects or periods that receive comparatively less attention.

The historical study data also provides a basis for performance prediction. By analyzing study duration and consistency, the system generates an estimated future performance level. However, the reliability of the prediction depends on the quantity and quality of historical study records. Study duration alone may not fully represent academic performance, as factors such as learning quality, attendance, assignments, and examination performance can also influence the results. Moreover, the dataset used in this study belongs to a single student over a short period, and the consistency value of 100% reflects a study session on every day of that period. Therefore, the results should be treated as a demonstration of the proposed system rather than a generalizable evaluation, and the performance score should be interpreted as an estimate based on study behavior, not as a validated prediction of examination results.

The use of Java Swing and CSV storage makes the proposed system simple, lightweight, and suitable for individual students. The system does not require a complex database or advanced infrastructure, making it easier to develop and use. However, the current implementation has limitations, including the use of a simple prediction approach and limited study-related attributes. Future versions can incorporate machine learning algorithms, larger datasets, database storage, graphical analytics, and additional academic parameters to improve the prediction capability.

6. CONCLUSION AND FUTURE WORK

6.1 Conclusion

The proposed Java-Based System for Personalized Study Tracking and Performance Prediction provides a simple and effective approach for monitoring and analyzing student study activities. The system records study details such as date, subject, duration, and description using a Java Swing-based interface and stores the data in CSV format. The collected study data is analyzed to generate total study duration, average study duration, active study days, subject-wise study patterns, and study consistency. Based on historical study behavior, the system also provides an estimated future performance level. The results show that the proposed system can help students understand their study habits, identify areas requiring additional attention, and support personalized performance analysis.

6.2 Future Work

In future work, the proposed system can be enhanced using machine learning algorithms, larger datasets, and additional academic parameters such as examination marks and attendance to improve performance prediction. The system can also be extended with database storage, graphical dashboards, and web or mobile interfaces for scalable and personalized learning support.

REFERENCES

[1] C. Romero and S. Ventura, “Educational Data Mining: A Review of the State of the Art,” *IEEE Transactions on Systems, Man, and Cybernetics, Part C (Applications and Reviews)*, vol. 40, no. 6, pp. 601–618, 2010.

[2] G. Siemens and P. Long, “Penetrating the Fog: Analytics in Learning and Education,” *EDUCAUSE Review*, vol. 46, no. 5, pp. 30–40, 2011.

[3] R. S. J. d. Baker and P. S. Inventado, “Educational Data Mining and Learning Analytics,” in *Learning Analytics: From Research to Practice*, J. A. Larusson and B. White, Eds. New York, NY, USA: Springer, 2014, pp. 61–75.

[4] Oracle Corporation, “Java SE Documentation,” Oracle. [Online].https://www.oracle.com/java/technologies/javase-documentation.html.

[5] Oracle Corporation, “Using Swing Components,” *The Java Tutorials*.[Online]. https://docs.oracle.com/javase/tutorial/uiswing/components/.

[6] J. Han, M. Kamber, and J. Pei, *Data Mining: Concepts and Techniques*, 3rd ed. Waltham, MA, USA: Morgan Kaufmann, 2011.

[7] G. James, D. Witten, T. Hastie, and R. Tibshirani, *An Introduction to Statistical Learning: With Applications in R*. New York, NY, USA: Springer, 2013.