

An Explainable AI-Based Adaptive Study Planner for Personalized and Stress-Aware Learning

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Abstract— Planning is essential. Students often know what to study but not how to study and when to study, due to increasing academic workload, stress and lack of personalized study planning tools. Existing study planners often generate static schedules. These fail to adapt to students changing priorities, productivity levels and mental wellbeing of the student. In this paper we present an AI-based adaptive study planner that generates personalized study schedules based on user preferences, deadlines and stress level. The proposed system integrates adaptive scheduling techniques, pomodoro-based time management, and a feedback – driven learning mechanism to continually improve scheduling recommendations. An explainable AI layer is added to provide explanations of schedule and recommend related real time course. The system takes inputs from the user including tasks, available time, and stress levels to dynamically adjust study plans and promote well being balanced learning. The proposed approach aims to enhance productivity, reduce stress, and improve efficiency by giving intelligent and flexible scheduling. The results depict improved task consistency, workload balance and adaptive personalization compared to conventional static study planning tools used by students.

Key Words - Artificial Intelligence, Adaptive Scheduling, Study Planner, Pomodoro Technique, Explainable AI, Student Productivity

1. INTRODUCTION

Achieving academic success requires effective study planning. Students often struggle not because they lack motivation or resources; it is because of the lack of structured personalized approach to manage their study time. Since academic workload is rapidly increasing with respect to multiple subjects, assignment deadlines students are experiencing stress and difficulty in being productive.

Traditional study planning methods such as manual schedules often fail to consider student's well-being and does not actually learn. Most of the existing digital study planners generate static schedules. These do not adapt to changes in student's behavior or care for their well-being. However student's study capacity and focus change on daily basis. This depends on student's stress, fatigue and subject difficulty. This schedule can therefore become ineffective and unproductive when unexpected happens or the student is too stressed. This lack of adaptability results in procrastination, inefficient use of time, and increased academic stress.

An intelligent study planner should not only organize tasks based on deadlines but also understand the learning patterns of students. By evaluating completion history, productivity trends, stress levels, and biological rhythm, the system can allocate workload more evenly. At the same time it is very important to incorporating wellness-aware

mechanisms so that improvements in academic performance does not come at the cost of a student's mental well-being. In this paper, we present an AI-based Adaptive Study Planner that integrates several intelligent features including priority-based task scheduling, stress-aware study planning, productivity tracking, and Pomodoro-based focus sessions. Also, the system incorporates an Explainable AI(XAI) component, which tells how and why certain scheduling decisions are made, and gives real time course recommendations related to that task.

2. RELATED WORK

Artificial Intelligence (AI) has significantly influenced modern educational technologies by enabling personalized learning and intelligent academic support systems. Several studies have explored adaptive learning platforms, real-time activity monitoring, educational data mining, and AI-driven personalized learning approaches to improve student engagement and learning efficiency. AI-based educational software and adaptive learning systems analyze learner interactions and performance patterns to deliver customized learning experiences and instructional recommendations [2]. Deep learning techniques have also been employed in adaptive e-learning environments to monitor student activities and engagement in real time, enabling improved understanding of learner behavior and participation [3]. Technology-enhanced learning environments such as robotics-based educational tools further support the development of cognitive skills and self-regulated learning among students [4]. Additionally, data mining and big data analytics have been applied to analyze large-scale educational datasets and identify patterns that support predictive decision-making in academic environments [5]. Various productivity and engagement applications have also been introduced to help students monitor their study habits and maintain a balance between academic tasks and daily routines [6]. Furthermore, deep neural network models have been utilized to detect and analyze behavioral patterns in real-time monitoring systems [7], while AI-based personalized learning platforms dynamically adapt learning materials and instructional paths based on student progress and performance [8].

Despite these advancements, many existing systems primarily focus on personalized content delivery, learner engagement monitoring, or educational data analysis rather than providing intelligent study scheduling and structured academic task management. Most available tools rely on static scheduling mechanisms or domain-specific adaptive learning approaches that do not dynamically adjust study plans according to student productivity patterns, workload distribution, or learning behavior. Recent research has proposed AI-powered smart study planners that integrate machine learning algorithms, behavioral analytics, and

adaptive scheduling techniques to generate personalized study schedules tailored to learner preferences, goals, and performance data. Such systems demonstrate improvements in learning efficiency and academic engagement when compared to traditional manual planning methods. However,

there remains a need for more comprehensive systems that effectively combine behavioral analysis, adaptive scheduling, and intelligent workload management within a unified learning support framework [9].

Table1. Comparison of Existing AI-Based Educational Systems

Study / Tool	Methodology	Limitation	Ref
Knewton	AI-driven adaptive learning platform	Does not provide integrated study scheduling or daily planning	[2]
Smart Sparrow	Real-time adaptive e-learning with learner feedback	Lacks predictive scheduling and automated time-management support	[3]
DreamBoxLearning	Adaptive mathematics learning through intelligent pacing	Limited to mathematics; lacks study planning features	[4]
Big Data Educational Analytics	Data mining techniques for analyzing educational datasets	Focuses on large-scale data analysis rather than personal study scheduling	[5]
MyStudyLife	Calendar-based study planner with reminders and task tracking	Not AI-driven and cannot adapt to learning behavior	[6]
DeepNeural Monitoring System	Behavioral monitoring using deep neural networks	Primarily designed for safety monitoring, not study management	[7]
Squirrel AI	AI-based personalized learning platform	Focuses on content delivery rather than intelligent scheduling	[8]

3. PROPOSED SYSTEM AND METHODOLOGY

The proposed AI-Powered Smart Study Planner consists of several interconnected components that work together to generate personalized and adaptive study schedules.

3.1. Task Management Component (User Intelligence Layer)

Among the different elements of the system, Task Management Modules acts as the system's data base. The user will enter the academic work, and this function will collect and maintain the data. Moreover, it keeps the data in a standard format for use by other modules of the system. Tasks are stored using the data structure:(Task ID, Subject Name, Deadline, Priority, Estimated Study Duration, Status).Functions include Making and changing tasks and other characteristics of the task, Erasing and confirming the completion of tasks. With an active task management system, you'll be able to analyze procrastination, consistency, and time of work. Once the tasks are captured and stored, this module offers task data.

3.2. Predictive Intelligence Component

The predictive intelligence uses the activity of the user and the historical completion of tasks to provide a view of the user. The Productivity Score of system is estimated based on task fulfillment, completion rate, overdue tasks, consistency and the ability to complete items in the planned study time. A user's **productivity score** is measured based on the overall engagement and motivation levels alongside the level of diligence. Compared to scheduling light tasks for a less productive user, the more productive user consistently performs heavier tasks. In the same manner, a **Schedule Confidence Score** indicates how likely is the user to be able to follow along with the schedule. The confidence score is estimated by analysing the finish behaviour, overdue tasks and stress level.

In order to assess which specific subject or task the user is falling short in, **weakness detection** is carried out. Functions that analyse the various aspects with a view to revealing a comparatively low completion rate for certain tasks or daily time spent.

3.3. Adaptive Study Scheduling Component (Core Intelligence Engine)

Proposed system's core intelligence is provided by the Adaptive Study Scheduling Component. The system is aimed at generating individualised study schedules by varying the workload automatically depending on academic priorities, cognitive capacity and user performance. The process of scheduling begins with retrieving incomplete tasks from the Task Management Module. Subsequently, daily study time is checked for schedule feasibility.

Assessment of Task Importance: Priority weight W_i is assigned to each task based on urgency of deadline and priority. Scheduling importance is greater for tasks of higher urgency.

Adjustment Based on Stress: The intensity of the workload adjusts depending on the user's stress levels. As stress increases the intensity of the session reduced.

Productivity-Based Load Adjustment: Patterns of user productivity are examined to find feasible workloads. If productivity is good, then more tasks may get scheduled and if it is poor, the schedule will be lighter.

Biological Rhythm Analysis: The system assesses efficiency patterns according to the time of the day (E_t) to identify periods of concentration peaks. We schedule more demanding tasks during times when the user is historically more focused

To determine optimal task allocation, the system computes a unified scheduling score:

$$S_i = W_i \times (\lambda_1 PS + \lambda_2 ECC + \lambda_3 E_t)$$

Where , **PS** represents productivity score , **ECC** represents effective cognitive capacity derived from stress levels , **E_t** represents time-of-day efficiency and coefficients $\lambda_1, \lambda_2, \lambda_3$ control the influence of these factors.

Tasks with greater scheduling score are prioritized first during schedule generation provided total assigned study time is not more than available daily study time.

3.4. Wellbeing Optimization Component

The Wellbeing Optimization Component aims to ensure that the study schedule remains balanced and sustainable in order to prevent overload and fatigue. To achieve this, the Pomodoro study technique, workload adjustment

mechanisms, and burnout prevention strategies are integrated into the system.

Study sessions are modeled using the **Pomodoro technique**, which consists of short intervals of focused study followed by brief breaks to avoid mental fatigue while maintaining concentration. The component also performs workload adjustment based on stress awareness by considering the user-reported stress level and cognitive capacity. As stress levels increase, the system either reduces study intensity or shortens study sessions so that the schedule remains realistic and achievable. This functionality helps users maintain a balanced learning routine while protecting their mental well-being.

3.5. Generative AI Explanation Component

The Generative AI Explanation Component enhances the transparency and usability of the study planner by providing interpretable insights about generated schedules.

The component performs two key functions:

- **Explainable Scheduling** – Explaining how and why schedules and tasks are generated

- **Feedback on Personalized Study Guidance** – Based on performance on the task, recommending learning material

Through its use of legit reasoning, the system does not just generate schedules but helps students to improve their performance as well.

3.6. Closed-Loop Feedback Learning Mechanism

The proposed system incorporates a closed-loop feedback learning mechanism that continuously improves scheduling performance using user interaction data. After each study session, task completion status, productivity patterns, and performance data are recorded. The metrics will improve productivity scores, cognitive capacity estimates, and time-efficiency patterns. The system generates personalised study schedules by continuing to adapt to the way a user studies, with the feedback process.

3.7. System Support and Interaction Component

This acts as an interface that users use to interact with the planner. It has interactive dashboard that allows users to view schedules, track task progress, and analyse performance insights. It helps users observe their study behavior and assess whether the generated schedules are actually helping them study better.



Fig 1. Architecture of the Explainable AI-Based Adaptive Study Planner

4. RESULTS AND DISCUSSION

The proposed Explainable AI-Based Adaptive Study Planner was implemented as a prototype web-based application designed to generate personalized and stress-aware study schedules. The system integrates task management, predictive intelligence, adaptive scheduling, and explainable AI components to support intelligent academic planning.

4.1 Dashboard Overview

The dashboard interface provides a summary of the user's study activity, including task completion rate, total study time, upcoming tasks, and AI recommendations. The dashboard serves as the central interface where users can monitor progress and access different features of the study planner.

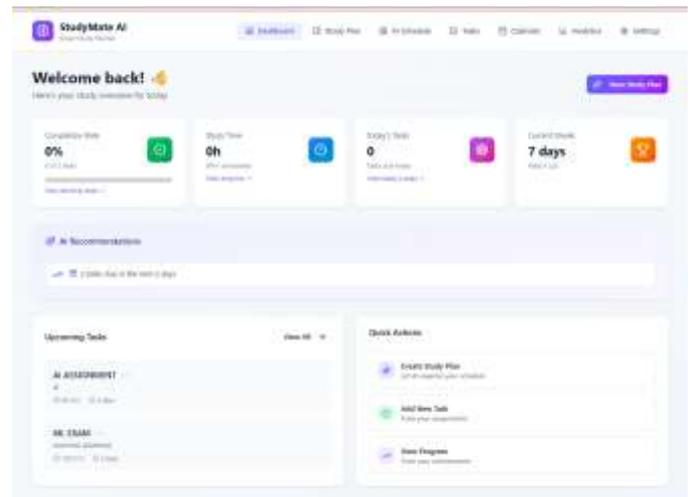


Fig. 2. Dashboard Interface of the Study Planner

4.2 Task Management Interface

The task management module allows users to create and manage academic tasks by entering details such as subject name, priority level, deadline, and estimated study duration. The system organizes tasks into different states such as pending, in-progress, and completed, allowing users to track their study activities effectively.

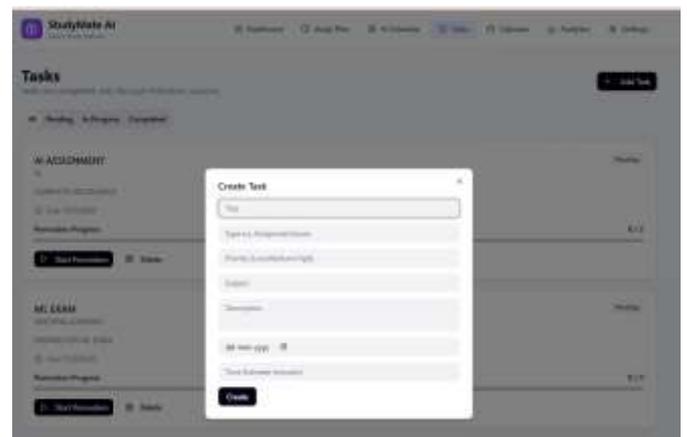


Fig. 3. Task Creation and Task Management Interface

4.3 AI-Based Study Plan Generation

The study planning module generates personalized study schedules based on user inputs such as daily study hours, productivity score, and stress level. The adaptive scheduling engine analyzes these factors to create a balanced and achievable study plan.

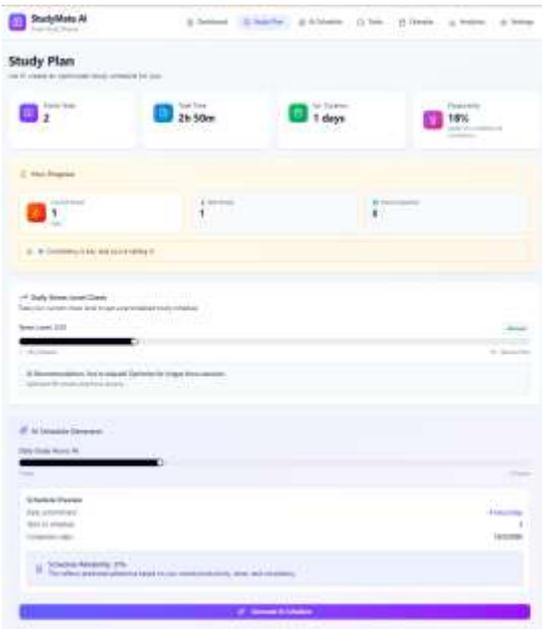


Fig. 4. AI-Based Study Plan Generator

4.4 Calendar-Based Schedule Visualization

The generated study schedule is displayed through a calendar interface that allows users to view tasks distributed across different days. This feature helps students manage their academic workload and track scheduled study sessions efficiently.



Fig. 5. Calendar View of Generated Study Schedule

4.5 Study Analytics and Performance Insights

The analytics module provides visual insights into the user's learning behavior and performance patterns. The dashboard includes graphs showing task completion rate, study time distribution, subject-wise task analysis, and weekly productivity trends.



Fig. 6. Study Analytics Dashboard

4.6 Explainable AI-Based Scheduling Output

The system also provides explainable insights into the generated study schedule. The Explainable AI component describes why specific tasks are scheduled at certain times

and recommends relevant learning resources. This improves transparency and helps users understand the reasoning behind scheduling decisions.

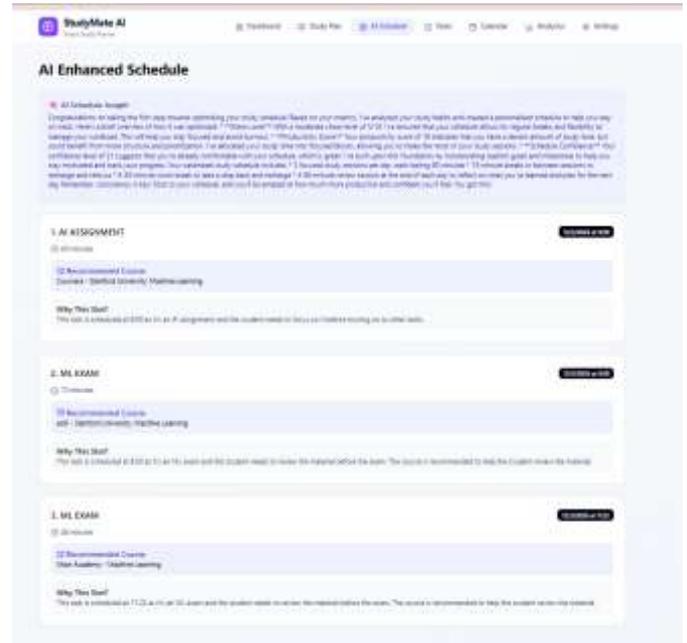


Fig. 7. Explainable AI-Based Study Schedule Recommendations

4.7 System Overall Performance

To evaluate the effectiveness of the proposed system, Table 2 presents a qualitative comparison between traditional study planning approaches and the proposed AI-based adaptive study planner.

Table 2. Performance Improvement of the Proposed AI-Based Study Planner

Metric	Traditional Study Planning	Proposed AI-Based Planner
Task Completion Consistency	Moderate due to static scheduling	Improved due to adaptive scheduling
Workload Balance	Often uneven and stressful	Balanced using stress-aware scheduling
Study Planning Efficiency	Manual planning requires more time	Automated AI scheduling improves efficiency

The results indicate that adaptive scheduling and stress-aware workload adjustment improve study consistency, workload distribution, and overall planning efficiency.

5. FUTURE SCOPE:

Integration of the suggested system with secure architecture would help to multi-user authentication. The cloud service will permit learners to utilize the same synchronized learning plan on different gadgets. The system can also be transformed into a native mobile application that integrates push notifications with real-time reminders. Another compelling avenue for research is the integration of the wearable gadgets to obtain biometric indicators, including stress levels, heart rate variability and sleep. Therefore, the system can leverage the information to adjust the student schedules in real-time for better study habits.

The expAI can now have additional features beyond just the essential item condition. Going forward, there will likely

be features that inform respective schedules preparation. An intelligent student revising for some examinations can take advice from a system that applies the intelligent student's ability to formulate a wise revision plan. In AI-driven educational space, we can say difficulty-aware scheduling may be a novel feature.

CONCLUSION:

In this paper, we present an intelligent study planner that applies AI techniques to assist students in organizing their study schedules more efficiently. Instead of utilizing static planners, the suggested system modifies study plans dynamically according to each user task priorities until time ends based on productivity patterns as well as stress levels. The enhanced learning experience is achieved through integrating adaptive scheduling with wellbeing-aware planning and explainable AI insights. In general, the study gives a sense of stability to the students helping them stay focused and leading towards an easier approach with less academic pressure to their endeavor towards achieving your goals with balance. Overall, the method is it's all about study consistency and reducing academic pressure and helping students to develop a healthy balance in terms of their studying approach.

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