

StudyPalz: A Personalized Academic Learning Path Recommendation System

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Abstract

The growing demand for adaptive learning software has highlighted the drawback of static content delivery. Focusing on content delivery, StudyPalz is an adaptive learning system designed to boost student productivity. Rather than offering generic content, it finds particular learning needs and provides modified tools including mind maps, short films, and mnemonic devices. Built on Django, StudyPalz starts with diagnostic quizzes to gauge conceptual knowledge. Depending on quiz results, it identifies weak areas and recommends focused study material as well as tailored re-attempt quizzes to strengthen learning.

In the interest of consistency and well-being, StudyPalz also includes a Pomodoro timer and task planner, encouraging focused, brief study intervals and good use of time. A field study of 150+ students and 200+ completed quizzes revealed misconceptions and the need for curriculum improvement, informing the potential for the platform to offer real-time feedback loops for instructors. Student feedback also indicated a preference for concise visual aids over static content. A case study of 10 students indicated a score improvement from 51 to 85 over five quizzes, representing a 66.67% improvement. StudyPalz overall integrates adaptive diagnostics, personalized content, and progress tracking to enable academic improvement. Its modular nature also provides opportunities for future AI-based tutoring and multilingual support.

Keywords: adaptive learning; Django framework; LMS; performance analytics; study path recommendation

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1. Introduction

This research work presents StudyPalz, a web application that has been developed to satisfy the needs of individualized learning demands via adaptive recommendation systems. Current educational institutions have a tendency to fall short in providing personalized attention to students. Most cookie-cutter conventional learning management systems rarely adapt to different student requirements or scale to individual learning pathways. StudyPalz seeks to solve this issue via a Django-backed web application that incorporates performance monitoring into adaptive learning processes. The heart of the platform is an adaptive quiz system that gauges student competence across many topics and subtopics. Through analysis of several performance metrics-completion rates, accuracy of responses, and time spent per question the system builds an individualized learning pathway that is always optimized in real-time in response to student advancements.

StudyPalz's comprehensive approach to learning support is what truly distinguishes it from other websites of this kind. In addition to identifying areas of weakness, the application works to strengthen them. It accomplishes this by incorporating productivity tools like a task manager and Pomodoro timer, suggesting targeted study aids and providing resources for guided revision. A more individualized, encouraging, and effective learning environment that is tailored to each person's potential and goals is produced by combining these resources to support academic needs as well as help with time management and self-discipline.

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New advancements in recommendation systems have focused on combining algorithms to help learners better navigate online learning platforms. For instance, Ma et al. proposed a multi-algorithmic recommendation which takes into account knowledge gaps and individual preferences to increase personalization [1]. This was followed by Li et al. introducing a graph-based recommendation model which aimed to improve coherence and consistency based on different educational contexts [2]. Mansouri et al. laid out the current trends, advantages, and notable areas of the need for future research in personalized learning path recommendations [3].

The capacity of AI-driven adaptive learning systems to customize course materials to meet the needs of specific students keeps getting better. Learning activities are dynamically modified by these systems in response to performance metrics and real-time feedback. An adaptive recommendation system was created by Nabizadeh et al. that can adjust learning paths while being used in response to feedback from students and progress monitoring [4]. A deeper dive reveals the critical role that machine learning and artificial intelligence play in optimizing the delivery of content [5]. Furthermore, the reinforcement learning models covered in [6] hold great promise for adjusting learning activities according to academic performance metrics and engagement trends.

Merging deep learning technologies with knowledge graphs has greatly enhanced personalized recommendations in educational technology. Wang et al. employed graph convolutional networks (GCNs) in an e-learning context, which allowed learning paths to be adapted in a more structured manner [7]. In Chen et al.'s research using LSTM-based neural networks, they successfully predicted what students would require in terms of learning in the future, which improved the accuracy of recommendations [8]. Reinforcement learning models described by Zhang et al. used network embedding techniques to enhance predictions of learning effectiveness in different contexts.

Multiple filtering techniques are combined in hybrid recommendation systems to improve learning path personalization. Engagement levels are significantly raised by taking into account elements like student preferences and learning styles [9,10]. Klačnja et al. and Boticario et al. discussed context-aware models that used hybrid approaches to tailor content delivery according to student interaction patterns [11,12]. Additionally, by examining user-generated metadata, collaborative tagging methods described by Khribi et al. have improved recommendations and produced more responsive learning environments [13].

A key component of customizing learning experiences is reinforcement learning. In order to improve knowledge retention, Tang et al.'s study used a reinforcement learning model to dynamically modify learning recommendations [14]. Yang et al. concentrated on real-time feedback mechanisms that adapt to students' changing knowledge levels while researching adaptive learning strategies [15]. Furthermore, using historical performance data, deep reinforcement learning models demonstrated promise in forecasting the best learning sequences [16].

Personalized learning path recommendations are still being advanced by AI-driven adaptive learning frameworks. Collaborative learning has been shown to improve with research on competency-based ontologies in virtual learning environments [17] and agent-based personalization strategies [18]. As discussed by Kumar et al. and Sharma et al., the incorporation of generative AI techniques opens up new possibilities for personalization and real-time content adaptation.

Thus, the extensive literature reveals critical gaps in existing personalized learning systems. While significant advancements have been made in recommendation algorithms and learning analytics, most existing platforms lack comprehensive, integrated support mechanisms. These research insights directly informed StudyPalz's feature development:

- Handwritten Notes: Addressing the need for personalized knowledge capture
- Personalized Resources: Responding to the call for tailored content delivery
- Doubt Solving Links: Providing immediate support for concept clarification
- Reattempt Quiz: Enabling iterative learning and mastery
- Pomodoro Timer: Integrating proven time management techniques
- Take Another Quiz: Supporting continuous self-assessment and learning

By combining these features, StudyPalz addresses the multifaceted challenges identified in existing research, creating a holistic, adaptive learning environment that goes beyond traditional one-size-fits-all approaches.

2. Methodology

StudyPalz is developed (Figure 1) using *Django web framework*, incorporating *HTML5*, *CSS3*, and *JavaScript* for the frontend implementation. The system architecture follows a *Model-View-Template (MVT) pattern*, with Django models handling data structure and quiz logic, views managing user interactions, and templates rendering the user interface. Table 1 shows the details of technical implementation.

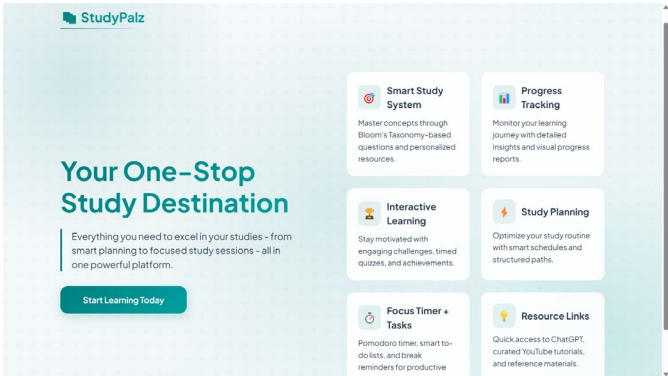


Figure 1. Home Page of StudyPalz

Table 1. Technical Implementation

Features	Details
Backend	
Django Framework	Implements the core quiz logic, user authentication, and database management
SQLite Database	Manages user profiles, quiz data, and performance metrics
Python Libraries	Utilizes built-in Django libraries for data processing and session management
Frontend	
HTML5/CSS3	Provides a responsive and intuitive user interface
JavaScript	Handles dynamic content updates and user interactions

Core System Components

- User Authentication and Profile Management

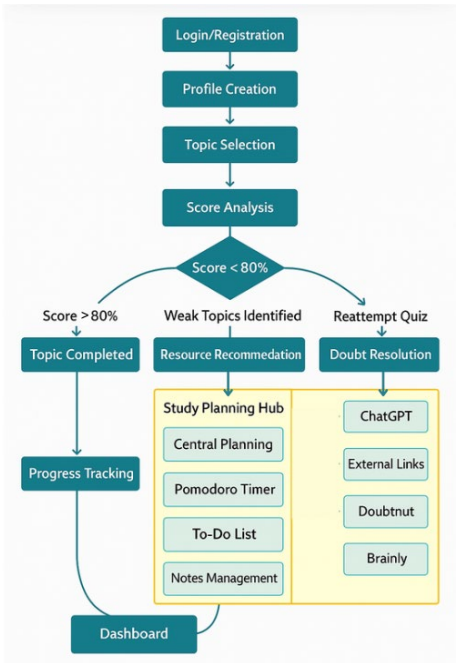


Figure 2. User Workflow of StudyPalz

As shown in the system flow diagram (Figure 2), the system begins with user authentication and is followed by profile creation. This module handles:

- User registration and login
- Profile creation
- Topic selection and initial assessment
- Assessment Engine
 - Dynamic question generation from topic pools (Figure 3)
 - Real-time score calculation (Figure 4)
 - Weak topic identification based on performance thresholds
 - Performance data storage and analysis



Figure 3. Quiz Pages

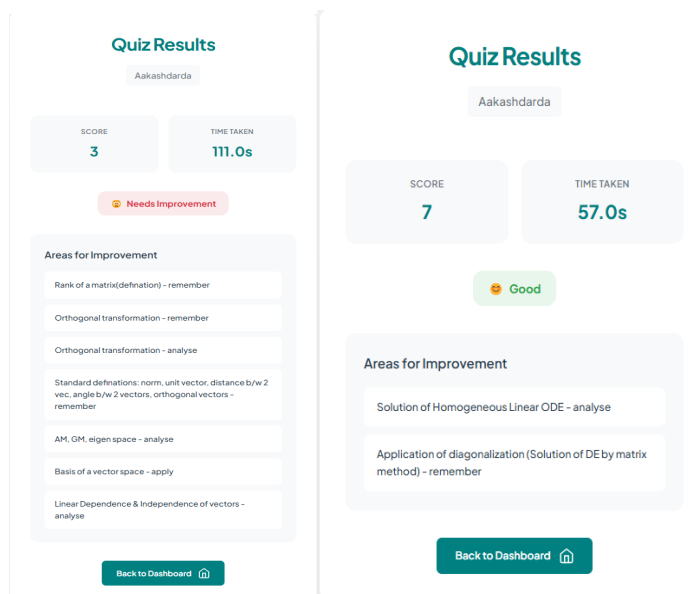


Figure 4. Quiz Results Page

- Resource Recommendation System

The intelligent recommendation process:

- Analysis of user performance metrics
- Identification of weak topics
- Curated resource recommendations based on difficulty levels

- Learning Path Implementation

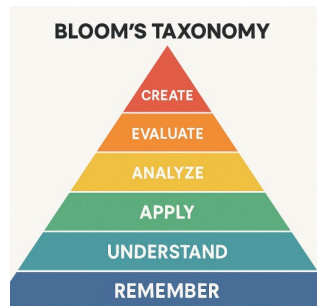


Figure 5. Bloom's Taxonomy

The system implements learning paths based on Bloom's Taxonomy (Figure 5), incorporating:

- Remember: Basic concept assessment through quizzes
- Understand: Resource comprehension tracking
- Apply: Practice exercises and problem-solving
- Analyze: Performance pattern recognition
- Evaluate: Self-assessment tools
- Create: Project-based learning opportunities

- Educational Framework Integration

The system's pedagogical approach is grounded in Bloom's Taxonomy, ensuring comprehensive learning coverage:

- Additional Feature

Study Planning: Includes tools such as a Pomodoro timer, to-do lists (Figure 6), and a notes management system to help students organize their study sessions efficiently.

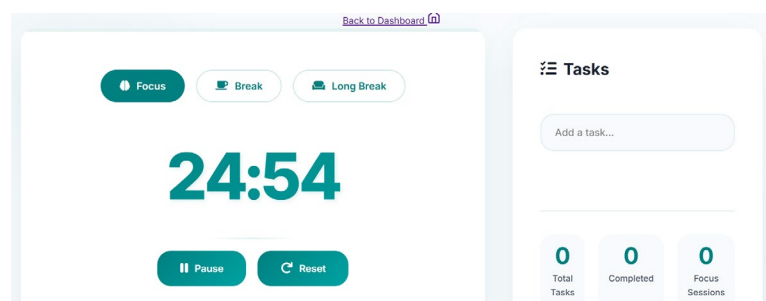


Figure 6. Pomodoro with to-Do List

Doubt Resolution System: Provides access to external learning resources like ChatGPT, Doubtnut, and Brainly, allowing students to quickly find answers to their questions.

Progress Tracking: Features a detailed dashboard (Figure 7) that helps students monitor their learning progress and identify areas for improvement.

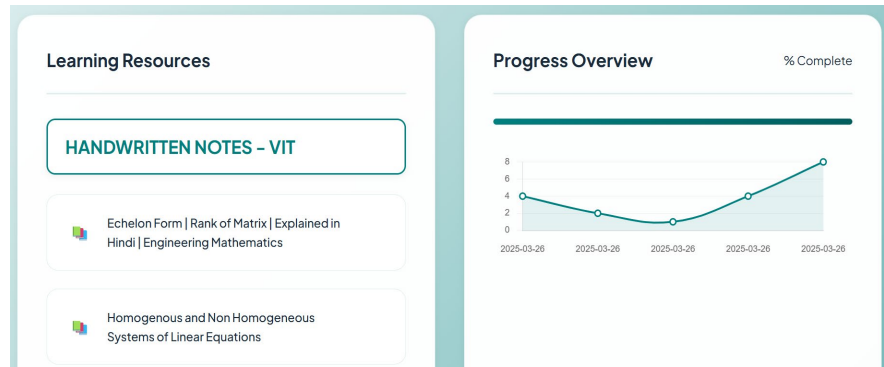


Figure 7. Student Dashboard - StudyPalz

The system's effectiveness is measured through:

- User engagement metrics
- Performance improvement tracking
- Resource utilization analysis
- Learning path completion rates

3. Results and Discussion

Phase 1 of our testing included over 150 students who took the initial quiz and used the personalized resources provided to them by StudyPalz, which helped them save time and work on only their weak areas. The students also reported Pomodoro timer and Learning Resources as their favorite features that helped them increase their efficiency and build sustainable habits for focusing. Further, we did a focused study on 10 students. Figures 8 and 9 shows reattempt quiz analysis and feature preferences.

Performance Trends - A study involving 10 students examined their progress over three quiz attempts on the StudyPalz platform, focusing on score improvements and feature usage. The initial assessment showed an average baseline score of 51 out of 100, highlighting areas where students needed improvement.

Score Progression - Over three quiz attempts, students demonstrated steady progress. In the first retest (Quiz 2), the average score increased slightly from 51 to 52. However, following attempts showed more noticeable improvement, with Quiz 3 reaching an average score of 82. After five days, students' scores stabilized at an average of 85.

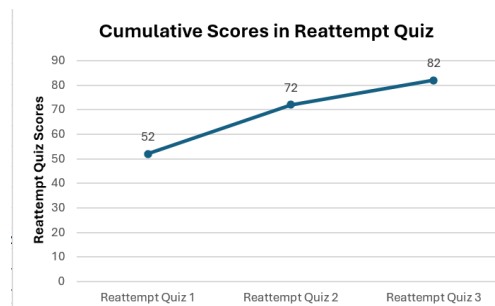


Figure 8. Reattempt Quiz Analysis

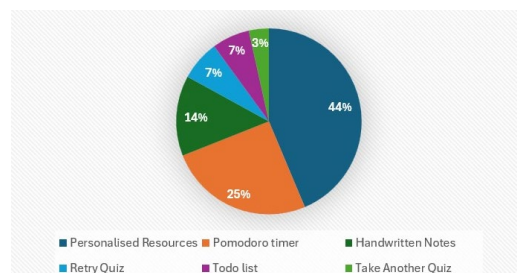


Figure 9. Feature Preferences

These steady improvements indicate that StudyPalz's step-by-step learning approach plays a meaningful role in helping students build their skills over time. The most notable progress was seen when raw scores were mapped to a standardized 10-point scale, highlighting the positive impact of repeated practice and focused learning efforts.

Personalized Resource

Feedback from students highlighted the value of personalized resources in supporting their learning journey. Two out of ten participants specifically pointed to these tailored materials as the most helpful aspect of the platform. Students like Mahie and Neel shared how customized content became a key part of their study routines, emphasizing the importance of aligning resources with individual learning needs.

Learning Tool

Students expressed enthusiasm about the platform's personalized video recommendation capability. Many participants indicated that before using StudyPalz, they often spent a long time on YouTube for "explanation videos" of which most did not relate to the learning targets and were of low quality. As one student remarked, "Finding good explanation videos used to take almost as much time as watching them." By providing curated content that addressed their learning gaps, StudyPalz streamlined these user's experiences by connecting them much faster with high-quality relevant content. The Pomodoro timer feature was also a widely used tool in the student participants' responses. Students shared that using the Pomodoro method improved their ability to focus through time management while studying. One sophomore engineering student said the timer "make it easier to commit to studying and not feel overwhelmed". The combination of a productivity technique with content recommendations seems to tackle both the what and how of studying and provides a more holistic learning support system than content-only platforms.

Platform Rating

The final ratings (Figure 10), calculated on a 5-point scale, ranged from 3.5 to 4.5, with an average of 4.15. This relatively high rating indicates overall student satisfaction and perceived value of the StudyPalz platform.

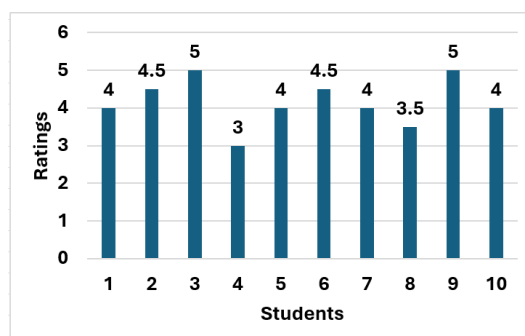


Figure 10. StudyPalz Ratings on 5

4. Implication and Recommendation

Iterative learning approaches can significantly improve student performance personalized resources and diverse learning tools are crucial for student engagement. The true power of StudyPalz lies in its integrated approach to learning, where multiple features work in concert to create a holistic learning experience. The platform demonstrates how technology can facilitate a sophisticated, multi-dimensional learning process. By combining personalized resources with time management tools like the Pomodoro Timer, the platform addresses both content understanding and study efficiency. The "Take Another Quiz" feature creates a continuous feedback loop, allowing students to immediately apply and test their learning. Meanwhile, the doubt-solving links provide just-in-time support, bridging knowledge gaps precisely when they emerge. This symbiotic feature integration mirrors how effective learning occurs in real-world contexts. Just as a skilled tutor would not only provide information but also guide study techniques, structure learning time, and offer immediate clarification, StudyPalz creates a digital equivalent of personalized mentorship. The data shows that students who extensively used these interconnected features, experienced the most consistent and significant performance improvements. Figures 11 and 12 shows the user data analysis and weak topic analysis. Figure 13 shows the backend administration.

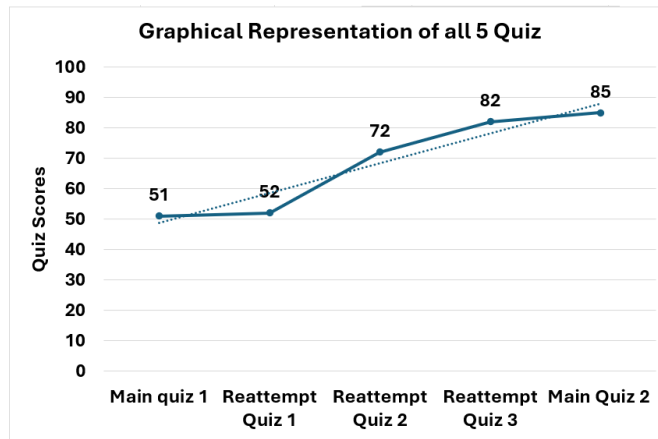


Figure 11. User Data Analysis

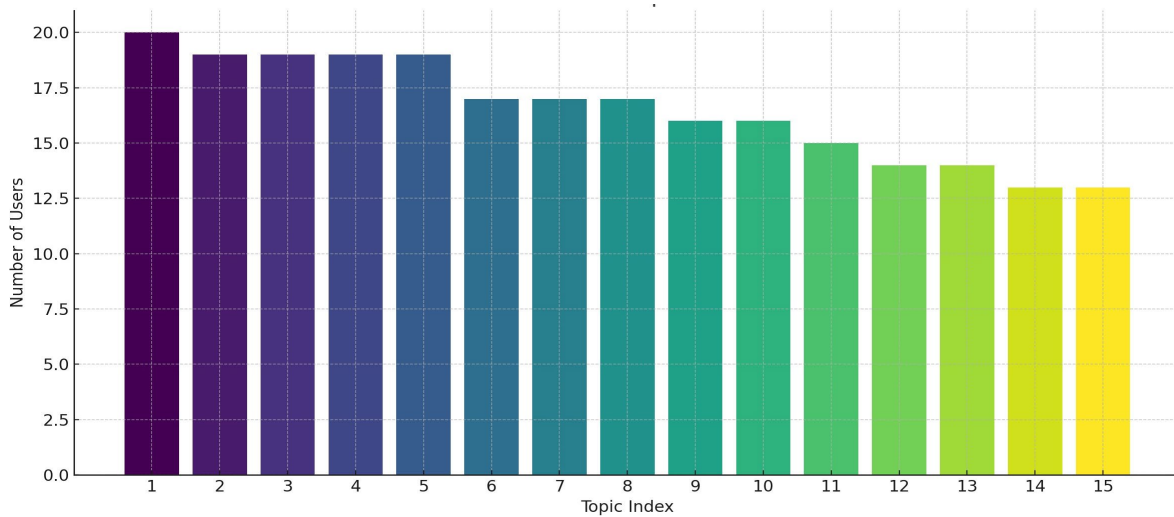


Figure 12. Weak Topic Analysis

Topic index of Figure 12 are following:

- 1) Echelon Form
- 2) Standard definitions, theorems
- 3) Derivation from 1st principles
- 4) Single var & 2 var tests
- 5) Unit roots
- 6) Convergence
- 7) JH
- 8) OLS
- 9) Coefficient of variation
- 10) Skewness
- 11) Standard deviation of means and covariance under variables
- 12) Assignment of disproportionate allocation of CL by random number
- 13) Measures of central tendency and dispersion - study
- 14) Variance
- 15) Solution of Unconstrained Linear ODEs, parameters

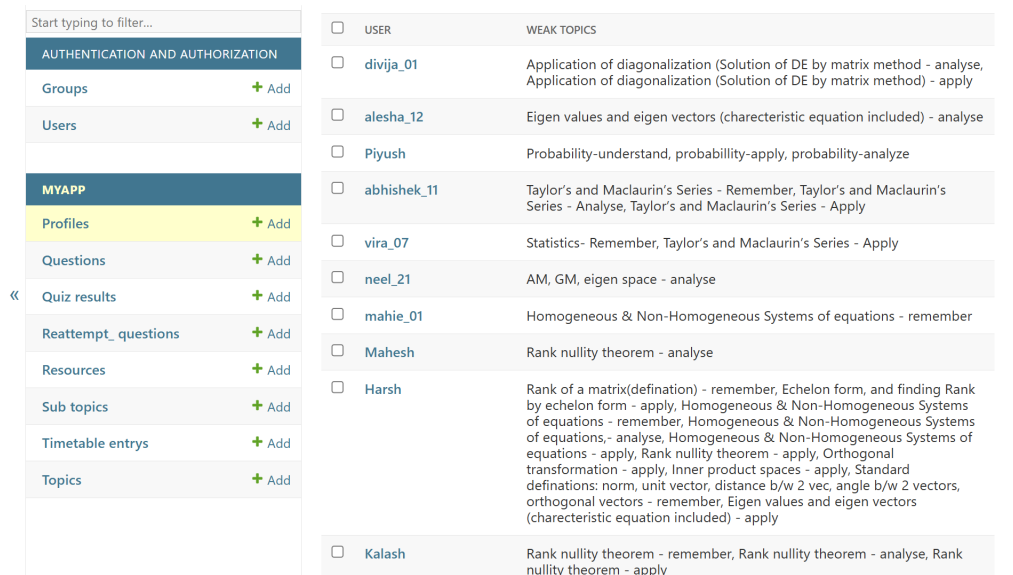


Figure 13. Backend Administration

5. Conclusion

StudyPalz introduces a transformative approach to personalized education by leveraging adaptive learning techniques, performance analytics, and intelligent resource recommendations. Through its dynamic quiz engine, automated weak topic identification, and structured learning path implementation, the system addresses the challenges of traditional one-size-fits-all learning models. The study demonstrates that personalized learning paths, when combined with intelligent analytics and targeted interventions, can significantly improve student performance and engagement.

Recurring learning gaps in particular topics were found through an analysis of more than 200 quizzes completed by more than 150 students. Teachers can use this pattern-based data to proactively modify their instruction, concentrating on frequently misunderstood topics even before classes start. Personalized resources and basic productivity tools, such as a Pomodoro timer and to-do list, greatly improve knowledge gaps, as demonstrated by a 66.67% improvement in a focused group. Instead of using traditional textbooks, students preferred visual and memory-aid-based resources like mind maps, brief videos, and mnemonic devices. This demonstrates a move away from rote memorization and towards effective, strategic learning. The students of today are optimizing, not disengaging. They look for tools that enable quicker, more efficient comprehension in a world that is overflowing with information. Platforms that support this way of thinking, such as StudyPalz, are ideally positioned to raise engagement and results.

Future Scope

The integration of AI-driven tutoring, offering real-time feedback and personalized learning support. Expanding StudyPalz to support multiple languages and regional education boards would improve accessibility and inclusivity. Integrating advanced data analytics tools would provide educators with deeper insights into student performance trends, enabling data-driven teaching strategies.

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