SupriAI: Artificial Intelligence Powered Learning Recommendation and Analytics System - Chrome Extension

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Abstract **- This project introduces an AI-driven Chrome extension that turns everyday web browsing into a personalized and intelligent learning journey. The extension passively tracks a user's learning-related activity such as the educational pages they visit, how long they engage with each topic, the depth of their interactions, and broader behavioral patterns and stores this information securely in a local database. By combining machine learning models with rule-based analytics, the system evaluates the user's evolving interests, identifies gaps in understanding, and monitors skill development over time. From these insights, it produces tailored study recommendations, including suggested next topics, curated learning materials, and structured, skill-oriented study sequences. A built-in analytics dashboard presents these findings through clear visualizations, highlighting trends in engagement, subject-level focus, growth indicators, and estimated proficiency progress. All analysis is conducted locally or via secure AI APIs, ensuring strong privacy protections and responsible data handling. By integrating browser-level tracking, intelligent analytics, and meaningful visual feedback, the extension serves as a smart learning companion one that boosts productivity, supports better learning outcomes, and enables self-directed, data-informed study planning.**

Keywords - AI Analytics, Chrome Extension, Personalized Learning, Learning Behavior Tracking, Recommendation System, Machine Learning, Learning Analytics, User Profiling, Data Privacy, Educational Technology.

I. INTRODUCTION

In This documentation template establishes a coherent formatting framework for presenting the Chrome-extension–based AI-Powered Learning Recommendation and Analytics System. It adapts the conventional structure of a technical paper to meet three central goals: (1) streamlining how authors organize material related to user activity monitoring, AI-driven behavior analysis, personalized study-path generation, and dashboard-level insights; (2) ensuring seamless compatibility with digital publication and indexing workflows; and (3) maintaining a uniform, professional tone and appearance across all sections of the project report. The template's predefined margins, column configurations, spacing rules, and text styles are designed to help writers clearly describe the system's architecture covering components such as Chrome API–based data collection, machine-learning modules for pattern detection, recommendation algorithms, secure data-handling mechanisms, and AI-supported visualization tools. Sample typefaces and formatting markers are included to guide the preparation of headings, narrative text, reference lists, figure captions, and table notes. While the template does not provide ready-made structures for elements like workflow diagrams, user-interface mockups, performance plots, or algorithmic flowcharts, it does supply standardized tables and stylistic options that allow these materials to be integrated smoothly. Authors may design these supplementary visuals as needed but should align them with the template's formatting conventions to preserve readability, consistency, and compliance with academic standards. Overall, this structured format supports clear, cohesive communication of the system's complete functionality. It enables readers to follow the project's technological contributions, implementation strategies, evaluation methods, and results with minimal effort, thereby strengthening the presentation of the proposed AI-enhanced learning tool.

II. RELATED WORK

A. Browser-Based Learning Analytics Systems

Although browser extensions and activity-tracking utilities are widely used for productivity monitoring, their role in learning analytics remains relatively undeveloped. Common Chrome extensions such as Stay Focused, Rescue Time, and Momentum primarily track time spent on websites or help limit distractions; however, they offer little insight into actual learning behaviors. Most existing browser tools cannot identify educational content, measure learning depth, or extract patterns from user interactions. Recent literature

stresses the need for more intelligent, browser-level analytics capable of interpreting page categories, engagement duration, and behavioral signals. These shortcomings reveal a clear research opportunity for a Chrome extension that moves beyond simple activity logs and integrates AI-driven analysis to interpret how users learn through their browsing activities.

B. Digital Learning Data Platforms

Modern learning environments including Coursera, Udemy, and Moodle provide built-in dashboards that visualize progress through metrics like quiz scores, completion rates, and personalized recommendations. However, these analytics systems are confined to their own platforms and cannot account for learning that occurs across the broader web. Studies show that today's learners frequently navigate between documentation pages, blogs, videos, coding platforms, and online courses, creating fragmented learning experiences that platform-specific dashboards fail to unify. As a result, cross-platform learning analytics has become a critical need. The proposed Chrome extension builds on this perspective by offering an integrated dashboard that aggregates learning activity from all web sources, capturing time allocation, topic shifts, skill focus, and long-term learning trends.

C. AI-Based Recommendation Technologies

Advances in machine learning have significantly enhanced recommendation systems across many domains. Platforms such as YouTube, LinkedIn Learning, and Google Discover demonstrate the effectiveness of algorithms built on content classification, sequential pattern analysis, similarity modeling, and collaborative filtering. Recent research highlights real-time behavioral cues scrolling activity, dwell time, revisit frequency, and search patterns as strong indicators of user interests. Drawing on these insights, the proposed system interprets raw browsing data to generate personalized learning guidance. By inferring user intent, estimating skill development, and recommending structured study paths, the extension adapts proven recommendation techniques to a browser-based educational setting.

D. User Behavior Tracking Frameworks

User behavior analysis has long been central to educational data mining, particularly through methods such as clickstream analytics, engagement modeling, and learning style detection. Traditional frameworks, especially those embedded in intelligent tutoring systems, typically depend on centralized data logs, large datasets, and extensive user information factors that raise privacy concerns. Emerging research instead advocates for local data processing, privacy-aware analytics, and lightweight monitoring techniques. The proposed Chrome extension embraces these principles by recording only essential learning indicators such as page category, time on task, topic frequency, and engagement depth and storing all information locally on the user's device. This approach maintains personalization while safeguarding user privacy.

E. Industry and Technology Practices

The growth of micro-learning tools and personalized digital coaching platforms such as Notion, Duolingo, Reclaim AI, and Skillsoft reflects increasing demand for real-time recommendations and adaptive learning experiences. These applications combine habit tracking, analytics, and AI-generated suggestions to support productivity and skill development. Yet most operate at the application level and cannot interpret learning behavior that occurs directly in the browser. Industry trends now emphasize intelligent assistants embedded into everyday workflows. The proposed AI-powered Chrome extension aligns with this shift by integrating behavioral tracking, machine-learning-based interpretation, and personalized recommendations into a single browser-native tool designed to support cross-platform learning.

III. Existing Systems

A. Browser-Based Activity Tracking Extensions

A variety of Chrome extensions currently exist to help users monitor how they spend their time online. Popular tools such as Rescue Time, Stay Focused, and Time Doctor provide summaries of web usage, categorize sites, and highlight productivity patterns. While these extensions are useful for managing distractions and improving time management, their scope remains largely limited to general productivity. They do not differentiate between learning-oriented content and non-educational browsing, nor do they interpret behavior through an academic or skill-development lens. The absence of AI-driven insights and learning-specific analytics leaves a significant gap one that the proposed system is designed to fill.

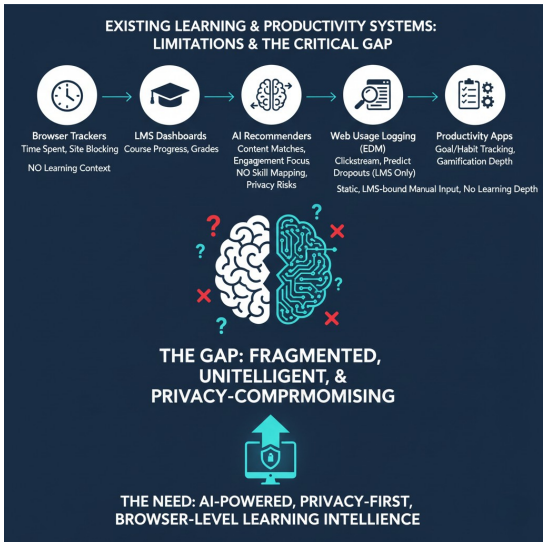

Fig. 1. Existing System

B. Platform-Specific Learning Analytics Dashboards

Major e-learning platforms like Coursera, Udemy, edX, and Moodle offer built-in dashboards that track user progress, quiz scores, video completion, and related metrics. Although these dashboards provide valuable feedback, they operate strictly within their own ecosystems. Learners who gather knowledge from multiple sources such as YouTube tutorials, coding documentation, technical blogs, MOOCs, or community forums receive fragmented analytics that fail to represent their overall learning activity. This limitation underscores the need for a browser-level analytics tool

capable of capturing and unifying insights from all learning interactions across the web.

C. AI-Based Recommendation Systems in EdTech

AI recommendation engines are already used in platforms like LinkedIn Learning, Google Discover, and YouTube, where algorithms analyze user engagement to suggest relevant content. These systems rely on techniques such as interest clustering, content-based filtering, and predictive behavior modeling. However, because they are confined to their respective platforms, they cannot assess learning patterns that emerge across the broader web. They do not track how much time users spend on educational articles, which topics they revisit, or how their interests evolve across multiple websites. This lack of cross-platform analysis creates a clear opportunity for a Chrome extension that can build personalized learning recommendations directly from browser activity.

D. Web Usage Logging and Educational Data Mining Tools

Educational data mining tools and intelligent tutoring systems (ITS) often analyze detailed interaction data—such as clickstreams, time-on-task metrics, or content navigation patterns to adapt instruction and predict student performance. While effective in structured learning environments, these systems depend heavily on centralized institutional frameworks and controlled platforms. As a result, they are not suitable for independent learners operating in open, browser-based contexts. Moreover, many existing solutions raise privacy concerns due to centralized data storage and remote server dependency. There is a noticeable lack of tools that offer meaningful learning insights while keeping data stored locally on the user's device something the proposed system directly addresses.

E. Productivity and Skill-Development Applications

Applications like Notion, Reclaim AI, Duolingo, and Todoist support habit tracking, personal productivity, and skill development. These tools often incorporate intelligent suggestions and adaptive feedback, but their analytics are tied to their own app environments. They do not monitor the spontaneous learning that happens across websites, nor do they automatically detect learning behavior without user input. Because they rely on predefined structures or manually created tasks, they fail to capture the full picture of a learner who navigates open web resources. None of these tools provide real-time, browser-level monitoring combined with AI-driven interpretation capabilities central to the proposed Chrome extension.

IV PROPOSED SYSTEM

The proposed AI-Powered Learning Recommendation and Analytics System – Chrome Extension is designed as an intelligent, browser-integrated learning companion capable of monitoring user behavior, interpreting learning patterns, and generating personalized study recommendations. It bridges gaps in existing systems by leveraging lightweight tracking, secure local data storage, AI-driven insights, and an interactive analytics dashboard. The architecture is divided into five major components:

A. System Architecture Overview

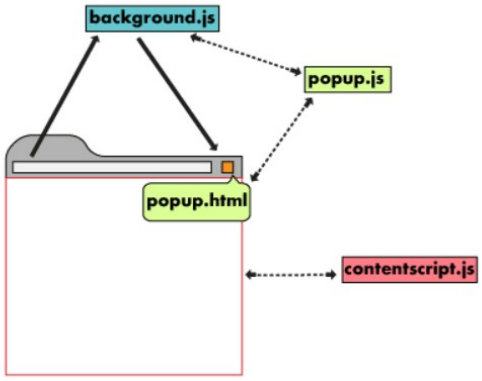

Fig. 2. System Overview

The system follows a modular pipeline consisting of:

1.Browser-Level Data Collection Layer

- Uses Chrome APIs (Tabs, History, Web Navigation, Alarms, and Mouse Tracking Events).
- Captures URLs, time-on-page, tab-switch frequency, scrolling depth, revisit patterns, interaction duration, and **mouse usage metrics** such as cursor movement, hover duration, click frequency, and idle cursor time.
- Analyzes mouse behavior to estimate **focus level, engagement depth, and attention flow** during learning activities.
- Identifies educational content using a **hybrid classification model** (keyword-based + ML-based page classifier).
- Ensures **minimal intrusion** by tracking only **learning-related browsing and interaction behavior**, maintaining user privacy and seamless experience.

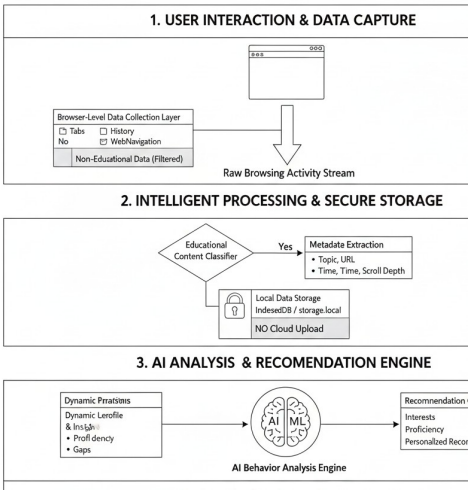

Fig. 3. Proposed Overview

2.Local Data Storage and Privacy Layer

- Stores all learning logs in Chrome's storage.local or IndexedDB.
- Data includes topic tags, timestamps, categories, and engagement depth.
- Enables user control features such as export, delete, or reset data directly from the dashboard.
- Integrates with Chrome's permission model to transparently disclose data usage and gain user trust.
- Implements audit logs (locally stored) to trace AI decision rationale and ensure explainability.

3.AI Behavior Analysis Engine

The core intelligence module performs:

- Performs **semantic similarity checks** across visited content to group related learning topics using embedding-based clustering.
- Integrates **difficulty estimation models** by correlating content complexity (e.g., text density, keyword rarity) with time spent and revisit frequency.
- Learning Pattern Detection (based on repetition, dwell time, sequential navigation).
- Enables **explainability by design** through logs or indicators that show why a specific recommendation or insight was generated.

4.Recommendation Generator

Uses rule-based heuristics + ML insights to provide:

- Suggested next concepts based on user progression.
- Curated learning resources (articles,videos,tutorials).
- Structured study sequences based on skill trees.
- Weekly summaries and personalized learning paths.

5.Interactive Analytics Dashboard

- Built using HTML/CSS/JS or React inside the extension's popup or new tab interface.
- Features include:
  - Topic-wise time distribution charts
  - Learning trends over days/weeks
  - Skill improvement indicators
  - Engagement depth visualizations
- Provides users with a clear understanding of how they learn across the web.

B. Functional Workflow

1. User opens browser → extension activates tracking.
2. AI models classify whether the webpage is educational.
3. Data stored locally (URL → topic → engagement metrics).
4. AI engine analyzes cumulative patterns daily/weekly.
5. Dashboard displays visual analytics.
6. Recommendation module provides next learning steps.

This complete workflow transforms passive browsing into a structured, AI-enhanced learning experience.

C. Advantages of the Proposed System

- Cross-platform Learning Analytics: Monitors all learning sources across the web.
- Privacy-Safe Architecture: No external servers, no personal data leakage.
- Dynamic Personalization: Recommendations evolve with the user's behavior.
- Minimal User Effort: Fully passive tracking no manual input required.
- Enhanced Learning Outcomes: Helps maintain consistency, track progress, and reduce fragmented learning.

V ACKNOWLEDGMENT

The successful completion of this project would not have been possible without the guidance, encouragement, and support of numerous individuals and resources. We would like to express our heartfelt gratitude to our project supervisor for their invaluable mentorship, consistent guidance, and critical feedback that shaped the direction and quality of this work. Their deep technical insight and unwavering support were instrumental at every stage of the project.

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We would also like to acknowledge the role of official documentation, academic research publications, and technical forums related to web development, behavioral analytics, and personalized learning systems. These materials served as vital references throughout the project lifecycle, providing clarity and direction during system design and integration phases.

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VI. CONCLUSION

The successful deployment of SupriAI: AI-Powered Learning Recommendation and Analytics System marks a shift toward intelligent, browser-based education. Unlike conventional e-learning platforms, SupriAI transforms casual web browsing into a structured and meaningful learning experience through local AI analysis, personalized recommendations, and interactive visualization. It ensures user privacy by storing all learning data locally, without sharing sensitive information externally.

Built around four pillars cross-platform tracking, personalized suggestions, local intelligence, and data visualization SupriAI empowers learners with real-time insights into their progress and behaviors. The extension monitors engagement patterns, identifies knowledge gaps, and provides dynamic study paths tailored to each user's

journey, all while ensuring performance efficiency and data confidentiality.

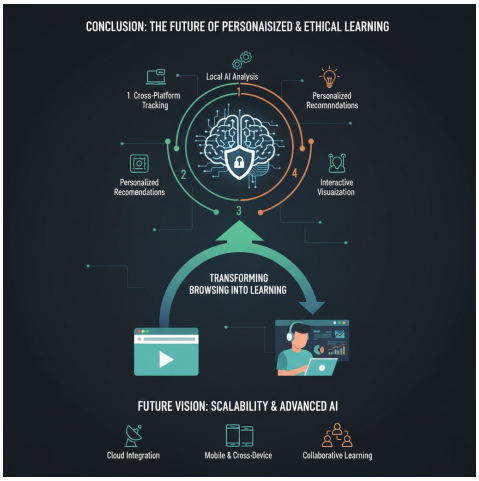

Fig. 4. Future Scope

Looking ahead, the future scope of SupriAI includes cloud integration for secure multi-device synchronization, mobile browser compatibility to expand accessibility, and collaborative features such as peer learning dashboards. With further advancements in natural language processing and adaptive assessments, SupriAI can evolve into a full-scale, intelligent learning companion fostering continuous, self-directed education across all platforms and devices.

SupriAI's vision aligns with the growing demand for decentralized, intelligent learning tools that adapt to the learner rather than requiring the learner to adapt to rigid systems. Its ability to function across diverse learning environments whether reading technical blogs, watching tutorials, or exploring online courses makes it a versatile companion for lifelong learners. As digital education continues to evolve, tools like SupriAI will play a crucial role in shaping a more personalized, privacy-conscious, and accessible future of learning.

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