Learner Profiling for Adaptive Learning in the MVP

Assumption: A learner may only take one course in the LMW. We need not deal with handling user historical data and trends(such as performance in other courses).

Attributes: For adaptive learning, we gain a comprehensive understanding of the learner through *learner profiling surveys*, *diagnostic assessment*, and *tracked patterns/trends*.

1. **Learner profiling surveys**

   Capture user-reported preferences and background data through onboarding forms.

a) Demographics

- **Captured Information:** Age, Class/Year, Courses Completed, GPA
- **Implementation:** Structured input form at the start of the course. Data stored in user profile metadata.

b) Learner Purpose

- **Options Provided:**
  - "I'm learning from scratch"
  - "I'm revising"
  - "I'm exploring"
- **Implementation:** Dropdown or radio buttons within the onboarding form.

c) Content Preferences

- **Captured Data:** Learner preferences for visual, audio, and text-based formats
- **Implementation:** Show 2–3 brief content samples in each format.
    - Metrics Captured:
        - Comfort Rating: 1–5 scale per format
        - Comprehension Check: 2–3 short quiz items per format
    - Data is used to infer preferred content delivery style.

d) Learning Style

- **Captured Data:**
    - Study mode (alone vs. group)
    - Session preferences (short chunks vs. long sessions)
    - UI styling (dark vs. light mode, element layout)
- **Implementation:** Multiple-choice survey. Stored as part of user experience customization data.

2. **Diagnostic assessment**
   Used to implicitly detect user knowledge gaps and strengths before course engagement begins.

a) Prerequisite Mastery Check

- **Purpose:** Evaluate mastery of foundational topics relevant to the course
- **Implementation:**
    - Quiz: 5–8 targeted multiple-choice questions per prerequisite topic
    - Scoring:
        - Topic Score: Percentage correct

        - PMI (Prerequisite Mastery Index): Average across topics
    - Categories:
        - Novice: PMI < 50
        - Developing: 50 ≤ PMI < 75
        - Proficient: PMI ≥ 75
    - Intervention:
        - Novice and Developing users receive "Foundation Mini-Modules"—short, prerequisite refreshers delivered at the beginning or alongside the course content.

b) Learner Skills Check

- **Skills Covered:** Math, reasoning, logic, memorization, application, coding, debugging
- **Implementation:**
    - One micro-task per skill (e.g., logic riddle, code snippet)
    - Scoring: 0–10 scale per skill
    - Overall Skill Score: Mean of individual skill scores
    - Skill Level Categorization:
        - Weak (0–3), Average (4–7), Strong (8–10)
    - Intervention: Weak and Average skills trigger "Skill Mini-Modules" embedded within regular course units.
    - Each quiz/assessment item is pre-tagged with the skill it targets. Lacking skills are prioritized in future questions.

c) Learner Course Objectives Check

- **Purpose:** Evaluate familiarity with core course objectives
- **Implementation:**

- Users self-rate each course objective (0–5 scale: "I know this" to "I've never seen it")
- Followed by 2–3 multiple-choice or short-answer questions per objective
- Scoring: Combined rating + correctness (0–10 scale)
- Categories: Weak (0–3), Average (4–7), Strong (8–10)
- Intervention: Questions targeting weak objectives are repeatedly pushed until competence is demonstrated.

d) Writing Style Check

- **Purpose:** Understand user's natural writing tone and structure
- **Implementation:**
  - Present 2–3 short-form writing prompts (e.g., "Explain X in your own words")
  - Use NLP-based analysis to measure:
    - Average sentence length
    - Vocabulary richness (type-token ratio)
    - Tone markers (pronoun usage, contractions)
  - Style Categories: Formal–Analytical, Conversational, Concise–Direct, etc.
  - **Use Case:**
    - Chatbot responses and AI-based feedback are styled to mirror the learner's writing, creating a familiar interaction experience

Micro-Module Interventions

- Based on diagnostic results, inject bite-sized content:
  - Foundation Mini-Modules (prerequisites)
  - Skill Mini-Modules (weak cognitive/technical skills)
  - Objective Remediation Modules (course objectives)
- Each module is tagged by the skills & objectives it targets, so the platform can automatically surface the right mini-lesson whenever a learner's score falls below the threshold.

3. Tracking User Patterns and Trends

Real-time adaptation through platform activity monitoring during course usage.

a) Learning Path Adherence

- **Purpose:** Identify whether the learner is following a structured or exploratory approach
- **Implementation:** Track the chronological order and timestamp of module completions. Deviation from the expected path signals an exploratory learning style.

b) Learning Pattern Analysis

- **Captured Data:**
  - Time spent on content elements (quiz, assessment, video, question generator, mindmap, etc.)
  - Frequency and type of interaction (clicks, scrolls, typing)
- **Implementation:** JavaScript event listeners record per-element engagement. Analyzed to infer content preferences and learning focus.

c) **Retention Span**

- **Purpose:** Determine attention span by measuring uninterrupted study sessions
- **Implementation:**
    - JS-based idle timers monitor user activity (mouse, keyboard, scrolling)
    - Capture average session duration before a break
    - Used to dynamically recommend or create modules of matching length.

d) **Performance and Confidence**

- **Purpose:** Calculate Topic Confidence Scores
- **Implementation:**
    - Inputs: Quiz scores, AI questions asked, assignment scores
    - **Scoring Algorithm (Rule-Based):** Weighted sum of quiz results, number of retries, hint requests, and chat history
    - **User Feedback:**
        - A “Further Revision Feedback” section under each subtopic allows users to list areas needing repetition
        - Combined with Topic Confidence Score to decide whether to re-surface content

e) **Confidence Thresholding**

- **Purpose:** Decide if the user has sufficiently mastered a concept
- **Implementation:**
    - Confidence threshold (e.g., score > 7/10 + no revision feedback)
    - If not met, additional practice and revision is auto-scheduled

f) **Hint-Based Quiz Adaptation**

- **Purpose:** Provide skill-aligned hints after incorrect answers
- **Implementation:**
    - Use pre-identified weak skills from diagnostic and surveys to generate targeted hints (e.g., for weak logic skills, show intermediate steps)
    - Explanations follow final submission and clarify mistakes to guide toward correct thinking

Not in scope for MVP, but could be looked at later:

a. Track user-specific performance insights from all courses taken in LMW, to help create a digital twin persona for the user

Event-driven interaction based on learner profiling attributes–

1. Learner Profiling Surveys (Onboarding Attributes)

a. Learner Purpose Selected

Event: User selects their purpose (e.g., “I’m learning from scratch”)
System Response:

- Adjust initial module difficulty:
    - *"From scratch"* → Start with foundation units + more guidance.
    - *"Revising"* → Skip intro content and prioritize application-based exercises.
    - *"Exploring"* → Show course map + let user choose entry point.
- On-screen prompt:
  “Great! We've tailored your journey for [selected purpose]. You can adjust this anytime.”

b. Content Format Preference Detected

Event: Learner rates content formats (e.g., high comfort with visual, low comprehension in text)
System Response:

- Prioritize delivery of preferred formats (e.g., videos + diagrams)
- Deprioritize or supplement weaker formats with explanations or alternatives
- Prompt:
  “It looks like you learn best with visuals. We'll show you more visual-first content.”

c. UI Preference Selected (Dark Mode, Layout, etc.)

Event: User selects display or session style preferences

System Response:

- Immediately apply UI changes
- Store preferences for session persistence
- Trigger layout rearrangement for accessibility or study flow

d. Study Mode Indicated (Solo vs. Group)

Event: Learner selects “Group Mode”

System Response:

- Suggest collaborative elements (discussion prompts, peer quiz comparisons)
- Enable “Invite a peer” or “Share progress” widgets
- Trigger opt-in for community board or peer-pairing features

2. Diagnostic Assessment Events

a. Low Prerequisite Mastery Detected

Event: PMI < 75 after prerequisite quiz

System Response:

- **Foundation Mini-Modules** are **automatically inserted** into the course path.
- Dashboard notifies learner:
  “Foundational concepts have been added to help strengthen your base knowledge.”

- Learner **must complete** these modules before or alongside main course content.

b. Weak Skill Detected (e.g., low logic or math)

Event: Any skill score < 6 (on 0–10 scale)
System Response:

- Corresponding **Skill Mini-Modules** are **automatically embedded** into course content.
- These appear in-line within appropriate units.
- Tag-based targeting ensures that quiz questions and explanations focus more heavily on these weak skills.

c. Writing Style Categorized (e.g., Conversational)

Event: NLP style analysis complete
System Response:

- Chatbot and AI-generated feedback match the user's tone
  (e.g., conversational → more informal and friendly messages)
- Optional toggle shown:
  "Your feedback style has been personalized. Want to adjust tone?"

d. Course Objective Self-Rating = Weak

Event: Learner self-rates a course objective as unfamiliar
System Response:

- Auto-prioritize content and questions related to that objective
- Use spaced repetition to resurface related items

- Prompt:
  “This concept is new for you. We’ll check in again after a few lessons.”

3. Tracked Patterns and Usage Trends

a. User Idle for >5 Minute

Event: Mouse, scroll, or key inactivity exceeds threshold
System Response:

- Pop-up:
  “Still there? Need a break or want to resume?” → [Take Break] [Resume]
- If idle continues:
  - Session is auto-paused
  - User is notified: *“We’ve paused your session to help you keep focus. Resume when ready.”*
- Logged for retention span tracking

b. Exploratory Behavior Detected (skips around modules)

Event: Module completion order deviates from standard path
System Response:

- Prompt:
  “Exploring on your own? Want recommendations based on where you are?” → [Show Recommendations]
- Content path is recalibrated to allow more flexible progression
- Track user as ‘Exploratory Learner’ for ongoing adaptation

c. Frequent Hint Requests

Event: Hints requested on 3+ quizzes in a short span

System Response:

- Prompt:
  "Would you like additional support on [relevant skill]?" → [Enable Support Mode]
- Support Mode:
  - Preemptive hints
  - Annotated content
  - Optional "walkthrough" content

d. Repeated Incorrect Attempts

Event: Multiple wrong answers on same concept

System Response:

- Trigger enhanced explanation pop-up:
  "Let's go over this again, step by step."
- Option to:
  - Review foundational concept
  - Try scaffolded version of the question

e. User Flags Content for Revision

Event: Learner selects "Needs More Revision"

System Response:

- Automatically resurface that topic after 1–2 sessions
- Add to "Revision Needed" section of dashboard

- Prompt:
  “We’ll revisit this soon. You can also check it now if you’d like.”

f. Session Duration Matches or Exceeds Attention Span

Event: Learner sustains session equal to or greater than their average span
System Response:

- Suggest a break:
  “You’ve been focused for a while. Would you like to take a short break or continue?”
- Offer “Wind-down Activity” like a recap quiz or concept map

g. High Topic Confidence + No Feedback

Event: Quiz scores > 7/10, no feedback submitted
System Response:

- Mark subtopic as mastered
- Suggest advancing to next level content
- Optional: *“Feeling confident here. Want a challenge?” → [Try Advanced Topic]*

h. Mismatch Between Comfort Rating and Comprehension Score

Event: Learner likes a content format but performs poorly in its quiz
System Response:

- Prompt:
  “It seems you enjoy this format, but might need help with it. Want to combine it with another format for now?”

- Suggest dual-format delivery (e.g., video + transcript)