**(Invention Title)**

### **A SYSTEM AND METHOD FOR A DYNAMIC, AI-DRIVEN ADAPTIVE LEARNING ENVIRONMENT**

(Inventors)

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**(Field of the Invention)**

The present invention relates generally to the field of computer-implemented educational technology. More specifically, it pertains to systems and methods for providing a personalized and adaptive learning experience by utilizing a generative artificial intelligence model to dynamically create curricula, deliver multi-modal content, and proactively manage a user's study schedule based on performance analytics and cognitive models.

**(Background of the Invention)**

The field of computer-based learning and Learning Management Systems (LMS) is well-established. Conventional systems typically operate on a static content model, wherein a predefined curriculum consisting of fixed lessons, videos, and assessments is presented to all users uniformly. While effective for information dissemination, this "one-size-fits-all" approach suffers from significant limitations.

First, such systems lack personalization. They are incapable of adapting to an individual user's pre-existing knowledge, preferred learning style, or specific academic or professional goals. A user is forced to follow a rigid learning path, which can lead to disengagement and inefficient use of time, as they may be forced to review material they have already mastered or struggle with concepts without adequate support.

Second, the content is not dynamic. The creation of educational material is a labor-intensive process, which limits the breadth of available courses and prevents the content from being tailored to a user's specific needs or weaknesses. If a student learns best through analogy, but the provided content is purely text-based, their learning efficacy is compromised.

Third, assessment methods are often rudimentary, relying heavily on multiple-choice questions that primarily test recognition rather than true comprehension or recall. These systems lack the capability to evaluate complex, open-ended responses, thereby failing to assess higher-order thinking.

Fourth, revision and long-term retention are poorly managed. While some systems may offer flashcards or review materials, they typically lack an intelligent scheduling mechanism based on established cognitive science principles, such as the spacing effect or the forgetting curve. The onus is on the user to determine when and what to review, which is often suboptimal for long-term memory consolidation.

Therefore, there exists a significant and unmet need for a learning system that can overcome these limitations by providing a truly dynamic, personalized, and adaptive educational experience. Such a system would ideally be capable of generating custom curricula on demand, adapting content delivery to user preferences, assessing complex user inputs, and intelligently managing the learning process to maximize long-term retention.

**(Brief Summary of the Invention)**

The present invention provides a system and method for a hyper-personalized, AI-driven educational ecosystem that overcomes the deficiencies of prior art. The system integrates a generative artificial intelligence model to create a continuous and adaptive feedback loop between the user and the learning platform.

In one aspect of the invention, a method is provided wherein the system receives an unstructured textual input from a user, such as a syllabus or a list of topics. A generative AI model processes this input to produce a structured curriculum, comprising a plurality of modules and lessons, which is then presented to the user as a personalized study plan.

In another aspect, for any given lesson within the curriculum, the system can dynamically generate content in multiple modalities. Based on user interaction data and an identified user "learning persona," the system can generate tailored content such as detailed notes, real-world analogies, or practical examples.

Furthermore, the system provides for adaptive assessments, including AI-generated quizzes that are tailored in difficulty and focus based on the user's performance history. A key innovation is the system's ability to receive and grade open-ended, free-text user responses using the generative AI, providing a nuanced score and constructive feedback.

A central feature of the invention is its adaptive mastery and scheduling engine. The system tracks a user's performance on assessments to compute a **Mastery Score** (representing immediate knowledge) and a **Memory Strength** (representing long-term retention). This Memory Strength metric, derived from a computational model of the cognitive forgetting curve, is used to calculate the optimal time for the next review of a given topic. The system then proactively manages the user's schedule, automatically adding targeted review sessions to combat memory decay and ensure long-term knowledge consolidation. This proactive intervention engine transforms the platform from a passive content repository into an active learning partner.

**(Detailed Description of the Invention)**

The present invention is a system and method for providing a personalized adaptive learning environment. The system is preferably implemented on a server computer in communication with one or more client devices over a network, such as the Internet. The core of the system is an orchestration of a user database, a content database, and a generative artificial intelligence (AI) model.

The process flow of the system can be understood through its primary operational phases:

1. Dynamic Curriculum Generation:

A user initiates the process by providing an unstructured text input representing a desired field of study. This input is transmitted to the system's AI utility module. The AI model is prompted with specific instructions to analyze the text and generate a structured data object, preferably in JSON format, that delineates a logical curriculum. This curriculum comprises a hierarchy of StudyPlan, Module, and Lesson entities. This generated structure is then stored in the system's database, associated with the user's profile. This method overcomes the static nature of prior art by allowing for the creation of infinite, user-defined courses.

2. Adaptive Content Delivery and Persona Modeling:

For each Lesson in the user's curriculum, the user can request content. The system logs all user interactions, such as which content types are requested (e.g., notes, analogy, example) and any explicit feedback provided (e.g., a "helpful" rating). This interaction data is analyzed by a detect\_learning\_persona function to classify the user's preferred learning style. When a content request is made, this persona is passed as a parameter to the AI model, which then generates content in a style and format tailored to that user's preference. For instance, a user identified as a "Practitioner" will receive more code examples for a technical topic.

3. Intelligent Assessment and AI-Grading:

Upon completion of a lesson, the user is presented with an assessment. The system's generate\_quiz\_questions function prompts the AI to create a quiz. This prompt includes data from the user's profile, such as their current mastery level on the topic and historical areas of weakness (e.g., "conceptual" vs. "terminology" questions). A novel aspect of this assessment phase is the handling of open-ended questions. The user submits a free-text response. The system sends this response, along with the original question and a pre-defined grading rubric, to the AI model. The AI is instructed to return a nuanced floating-point score and a sentence of constructive feedback, which are then stored and presented to the user.

4. The Adaptive Mastery and Scheduling Engine:

This engine forms the cognitive core of the invention. After each assessment, the system executes the following steps:

a. Performance Analysis: The user's score on the quiz is processed.

b. Mastery Model Update: Two key metrics in the Mastery database model are updated for the user and the specific lesson:

i. Mastery Score (M): A reactive score representing immediate knowledge, directly calculated from the recent assessment result.

ii. Memory Strength (S): A durable score representing long-term retention. This metric is updated using a formula that considers the previous strength, the time elapsed since the last review (decay), and the user's current performance (gain).

c. Spaced Repetition Calculation: The updated Memory Strength (S) is used as the primary input to a function that calculates the optimal interval for the next review session. A higher strength results in a longer interval, in accordance with the principles of the spacing effect.

d. Proactive Scheduling: The system automatically populates a ScheduledTask in the user's calendar for a "Review" session on the calculated future date.

5. Proactive Intervention Engine:

The system operates continuously in the background to ensure the user remains on an optimal learning path. A maintenance function (perform\_daily\_schedule\_maintenance) runs periodically (e.g., nightly). This function queries the database to identify any Mastery records where the Mastery Score has fallen below a predefined threshold or any ScheduledTask that was missed by the user. Upon identifying such a trigger, the engine initiates an intervention. This may include automatically scheduling a new review session for a weak topic, generating new targeted flashcards to address a specific knowledge gap, and sending a system notification to the user informing them of the action taken and the pedagogical reason for it.

**(Claims)**

What is claimed is:

1. A computer-implemented method for providing a personalized adaptive learning environment, the method comprising the steps of:
   * Receiving, by a server computer, an unstructured text input from a user device, said input defining a topic of study.
   * Processing, via a generative artificial intelligence model, said unstructured text input to generate a structured curriculum comprising a plurality of lessons.
   * Storing said structured curriculum in a database in association with a user profile.
   * Receiving a request from the user device to view a lesson.
   * Generating, via the generative artificial intelligence model, educational content corresponding to said lesson.
   * Transmitting said educational content to the user device.
   * Generating, via the generative artificial intelligence model, an assessment comprising one or more questions related to said lesson.
   * Receiving from the user device one or more answers to said assessment.
   * Calculating a performance score based on said answers.
   * Updating a mastery model for said user and said lesson in the database, wherein said mastery model includes at least a memory strength parameter.
   * Calculating a next optimal review date for said lesson based on said memory strength parameter.
   * Automatically creating a scheduled task for a review session on said next optimal review date.
2. The method of claim 1, wherein the step of generating educational content is further based on a user learning persona, said persona being determined by analyzing a history of the user's interactions with different types of educational content.
3. The method of claim 1, wherein the assessment comprises at least one open-ended question, and wherein the step of calculating a performance score comprises:
   * Transmitting the open-ended question, a grading rubric, and the user's free-text answer to the generative artificial intelligence model.
   * Receiving from the generative artificial intelligence model a numerical score and constructive feedback for said free-text answer.
4. The method of claim 1, wherein the memory strength parameter is calculated based on a computational model of a cognitive forgetting curve, said model considering at least the user's current performance score, a previous memory strength value, and a time interval since a previous assessment on said lesson.
5. The method of claim 1, further comprising the step of proactively monitoring the user's mastery model and, upon determining that a mastery score for a lesson has fallen below a predefined threshold, automatically creating a scheduled task for a review session for said lesson.
6. A system for providing a personalized adaptive learning environment, the system comprising:
   * A server computer with a processor and memory.
   * A database for storing user profiles, curricula, and mastery models.
   * A generative artificial intelligence model.
   * Program instructions stored in memory and executable by the processor to perform the method of claim 1.
7. The system of claim 6, wherein the program instructions are further configured to perform the method of claim 2.
8. The system of claim 6, wherein the program instructions are further configured to perform the method of claim 3.
9. The system of claim 6, wherein the program instructions are further configured to perform the method of claim 4.
10. The system of claim 6, wherein the program instructions are further configured to perform the method of claim 5.