EZYer: A simulacrum of high school with generative agent

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INTRODUCTION

Despite the rapid advancement of online education and large language models, existing educational tools still fall short in key areas such as courseware generation, interactive note creation, and content reliability. Most tools lack completeness, interactivity, and high-quality output—especially in generating LaTeX Beamer courseware.

To address these limitations, we propose EZYer, a generative educational agent tailored for high school mathematics. Powered by DeepSeek-V3, EZYer integrates three collaborative modules:

- Teacher Module: Automatically generates structured teaching materials and LaTeX Beamer slides from text or uploaded documents, supporting image insertion and alignment with the official syllabus.
- Student Module: Simulates real-classroom learning through multi-role interaction (Teacher, Assistant, Top Student, Struggling Student), with a Note Taker summarizing and generating personalized PDF notes.
- Controller: Ensures academic quality via keyword filtering, role-based content validation, and dynamic correction mechanisms.

We further evaluate EZYer using five LLMs across five key dimensions—content accuracy, knowledge coverage, usability, formatting correctness, and visual design. The results demonstrate that EZYer consistently produces high-quality educational content and holds significant promise for real-world deployment.

Teacher Module

The Teacher Module of EZYer is designed to support high school teachers in generating high-quality LaTeX Beamer courseware efficiently, based on simple inputs such as text, keywords, or uploaded PDF/Word documents.

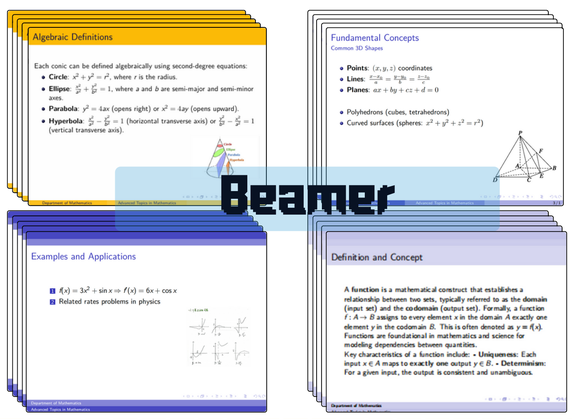
Three-Stage Workflow:

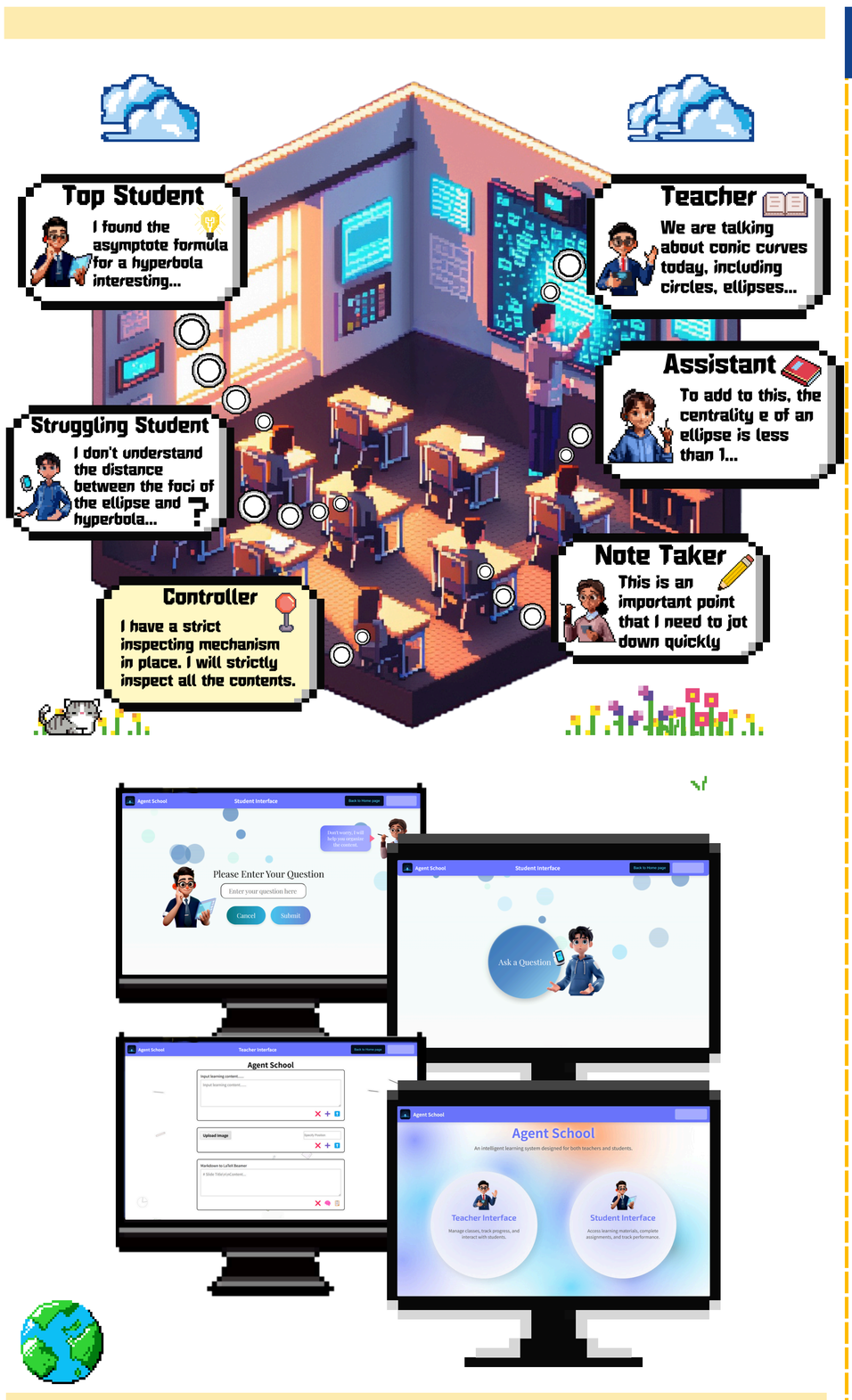
1. Input & Segmentation
2. Users enter raw content or upload documents. EZYer uses semantic boundary detection to segment the content into structured knowledge units.
3. Content Generation
   - If the input matches the Text Corpus, teaching materials and exercises are retrieved directly.
   - Otherwise, EZYer calls DeepSeek-V3 with structured prompts to generate academic teaching materials, including:
     - Definitions, key concepts, and math formulas in LaTeX
     - Exercises aligned with the curriculum
4. LaTeX Compilation
5. Users can insert images manually. EZYer then integrates all content into LaTeX Beamer format, escapes special characters and image paths, and compiles it into a ready-to-use PDF.

Core Technical Features:

- Uses multi-modal input and prompt templating for consistency and accuracy
- Ensures LaTeX-compliant output with correct formulas and visual structure
- Supports custom image insertion and generates well-structured Beamer slides

This design ensures structured, standardized, and pedagogically sound courseware, enhancing both preparation efficiency and instructional quality.





Student Module

The Student Module of EZYer creates a multi-role interactive classroom simulation to enhance student engagement, understanding, and note-taking. It models the natural dynamics of a real high school math class by coordinating five intelligent roles, each with specific learning functions.

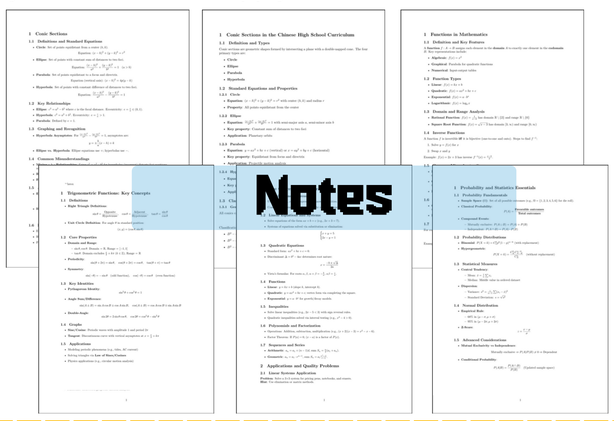
Five Role-Based Agents:

1. Teacher: Provides a clear, structured explanation of mathematical concepts based on curriculum standards.
2. Assistant: Enhances the teacher's response with more detailed elaboration and relevant examples.
3. Top Student: Raises deeper-level questions to promote critical thinking and enrich discussion.
4. Struggling Student: Simulates common misunderstandings and prompts clarification to reinforce correct concepts.
5. Note Taker: Synthesizes all role responses into well-formatted LaTeX academic notes.

Smart Workflow:

- Keyword Matching: User input is first matched with Text Corpus. If matched, Teacher uses it as the base to generate formal explanation.
- LLM Assistance: If not matched, EZYer calls DeepSeek API with predefined prompts to generate appropriate responses.
- Layered Dialogue: Each role processes and responds to prior content using context-aware prompts, enhancing both depth and clarity.
- Note Generation: Final notes are rendered in LaTeX format, structured for readability, and exported as a high-quality PDF.

By mimicking real-world classroom interaction, the Student Module enhances both learning quality and engagement, ensuring students don't just memorize — they understand and apply.



CONTROLLER

The Controller acts as the central coordinator in EZYer, managing the entire pipeline from input to output. It ensures that all generated teaching materials meet high school mathematics standards through multi-stage quality control.

Four-Layer Quality Control Framework

1. Keyword Filtering
   Validates input with regular expressions.
   Allows only high school-level terms (e.g., function, probability).
   Filters out advanced topics (e.g., linear algebra).
2. Content Scoring
   Uses DeepSeek API to rate generated responses (1–5 scale).
   Evaluates logic, relevance, and pedagogy.
   Score < 3 triggers re-generation.
3. Role Co-Validation
   Involves all speaking roles (Teacher, Assistant, Top Student, Struggling Student).
   Each builds on previous output, validating content from different perspectives.
   Inconsistencies lead to correction.
4. Dynamic Content Correction
   Auto-fixes keyword violations, low-quality responses, and LaTeX errors.
   Ensures clean, accurate, and well-structured final output.

With Controller, EZYer ensures reliable, curriculum-aligned, and LaTeX-compliant academic generation.

EVALUATION

Scoring mechanism

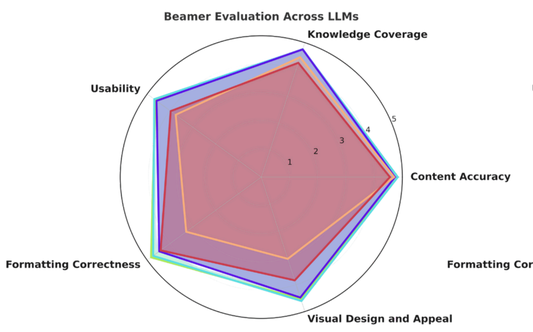
To ensure a fair and standardized evaluation of both Beamer and Notes outputs, we adopted a rigorous 0–5 scoring system (precise to two decimal places) based on clearly defined criteria.

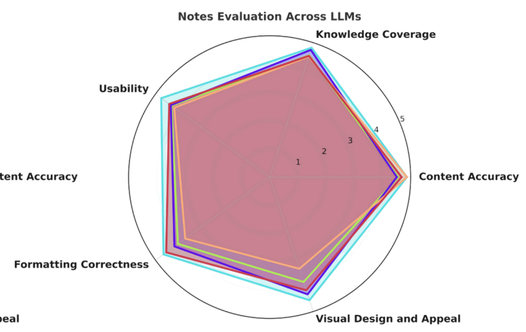
Table 1: Beamer File Quality Evaluation Table

	0-1	1-2	2-3	3-4	4-5
Content Accuracy	Misleading	Partially Correct	Generally Correct	Mostly Accurate	Fully Accurate
Knowledge Coverage	Minimal Coverage	Incomplete Content	Basic Coverage	Comprehensive	Full Coverage
Usability	Fragmented	Hard to Follow	Clear Enough	Easy to Understand	Highly Professional
Formatting Correctness	Major Errors	Format Issues	Minor Issues	Well-Formatted	Perfect Format
Visual Design and Appeal	Poorly Designed	Unbalanced Layout	Acceptable Visuals	Neat and Consistent	Aesthetic & Engaging

Table 2: Notes File Quality Evaluation Table

	0-1	1-2	2-3	3-4	4-5
Content Accuracy	Vague or Wrong	Some Errors	Mostly Correct	Minor Inaccuracy	Fully Accurate
Knowledge Coverage	Sparse Notes	Partial Concepts	Basic Key Points	Broadly Covered	Fully Covered
Usability	Disordered Notes	Hard to Review	Readable Structure	Clear and Concise	Logical and Helpful
Formatting Correctness	Major Issues	Inconsistent Style	Mostly Correct Format	Properly Structured	Fully Standardized
Visual Design and Appeal	Disorganized Style	Unclear Sections	Clean but Plain	Structured & Balanced	Elegant & Readable





Evaluation by Large Language Model

To assess the quality of EZYer outputs, 100 Beamer and Notes documents were evaluated using multiple large language models, each treated as an independent evaluator with distinct expertise. All evaluations followed the established scoring mechanism to ensure consistency and objectivity.

Table 3: Evaluation Results of Beamer Generated by Large Language Model

	ChatGPT-o1	Claude 3.5 Sonnet	Gemini-2.0-Pro	Qwen2.5-Max	GLM-4-Plus
Content Accuracy	4.84	4.84	4.74	4.71	4.56
Knowledge Coverage	4.76	4.76	4.75	4.46	4.25
Usability	4.65	4.69	4.59	3.75	3.97
Formatting Correctness	4.83	4.74	4.47	3.29	4.41
Visual Design and Appeal	4.54	4.61	4.48	3.04	3.84

Table 4: Evaluation Results of Notes Generated by Large Language Model

	ChatGPT-o1	Claude 3.5 Sonnet	Gemini-2.0-Pro	Qwen2.5-Max	GLM-4-Plus
Content Accuracy	4.56	4.87	4.51	4.87	4.68
Knowledge Coverage	4.53	4.81	4.73	4.48	4.51
Usability	4.30	4.75	4.33	4.18	4.4
Formatting Correctness	4.02	4.65	4.17	3.70	4.53
Visual Design and Appeal	3.90	4.58	4.36	3.41	4.21

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