Technology Empowering Education: Assessment of AI-Generated Lesson Plans for Self-Study Assistance in Resource-Limited Areas (Bijie, Guizhou) and Exploration of Localized Applications

I. Research Background and Objectives

Background

There exists an imbalance in educational resources between urban and rural areas, as well as between eastern and western regions in China. Bijie, as a prefecture-level city in Guizhou Province, may have relatively weak teaching staff and limited access to teaching resources (especially high-quality electronic devices and network resources) in some rural schools. Meanwhile, AI technology applications in education are emerging, but empirical research on their effectiveness in resource-limited areas is insufficient.

Research Objectives

1. **Empirical Assessment**: Through controlled experiments, scientifically evaluate the effectiveness differences between AI-generated lesson plans and traditional lesson plans in assisting student self-study
2. **Difficulty Insights**: Deeply understand the specific difficulties local students face in using electronic devices and accessing resources, providing basis for technology localization
3. **Needs Discovery**: Through field observations, gain insights into students' real learning habits, methods, and potential needs for new learning tools
4. **Product Prototype**: Based on research findings, design a self-study platform or manual prototype more suitable for students in Bijie (and similar areas) with low resource dependency

II. Core Research Content and Methods

This project will adopt a **mixed research approach** (quantitative + qualitative), divided into four phases:

Phase I: Preparation and Pre-research (1-2 weeks)

Main Tasks: 1. **Contact Research Sites**: Establish contact with 1-2 target primary and secondary schools in Bijie, obtaining participation permission from school administration, teachers, and students 2. **Ethics Preparation**: Prepare informed consent forms, clearly explaining research purposes, procedures, privacy protection measures, and their rights to schools, teachers, students, and parents 3. **Material Preparation**: Finalize AI lesson plans and traditional lesson

plans for testing (content and difficulty must be strictly matched); prepare pre-test/post-test questionnaires, interview outlines, observation record forms, and other tools 4. **Equipment Inspection**: Conduct on-site inspection of school computer rooms, availability of students' own devices, and network conditions, providing realistic basis for experimental design

Phase II: Quantitative Research - Controlled Experiments

Core Measurement Dimensions and Indicators:

We will measure "effectiveness" from four dimensions: 1. Learning outcomes and efficiency 2. Behavioral engagement 3. Emotional/cognitive engagement 4. Subjective experience and satisfaction

1. Learning Outcomes and Efficiency   Immediate Learning Achievement: - **Indicator**: Post-test standardized test scores - **Measurement Method**: Tests conducted immediately after the learning phase, including basic knowledge questions and application questions - **Analysis**: Use independent samples t-test to compare post-test average scores between AI group and traditional group, while using analysis of covariance with pre-test scores as covariates

Learning Efficiency: - **Indicator**: Time required to complete specific learning tasks - **Measurement Method**: Record the time each student spends from starting self-study to completing all learning materials - **Analysis**: Use t-test to compare average learning time between the two groups

Knowledge Retention: - **Indicator**: Delayed post-test scores - **Measurement Method**: 1-2 weeks after the first post-test, conduct another test using a questionnaire similar in difficulty and content to the post-test - **Analysis**: Compare delayed post-test scores between groups, evaluating which lesson plan brings more lasting knowledge memory

2. Behavioral Engagement   Task Persistence: - **Indicator**: Proportion of students who actively give up or fail to complete learning tasks - **Measurement Method**: Record how many students in each group stop before completing all materials - **Analysis**: Compare abandonment rates between groups (can use chi-square test)

Interaction Frequency: - **Indicator**: Number of times actively asking questions or seeking help - **Measurement Method**: In on-site observation record forms, record the number of times each student asks content-related questions to researchers or teachers - **Analysis**: Compare average question frequency between groups (t-test)

Note-taking Behavior: - **Indicator**: Proportion of students taking notes and word count/volume of notes - **Measurement Method**: Observe and record how many students in each group take notes, collect students' note papers for word

count or content analysis - **Analysis**: Compare note-taking behavior differences between groups

3. Emotional and Cognitive Engagement   Cognitive Load: - Indicator: NASA-TLX cognitive load scale (simplified version) scores - **Measurement Method**: After learning, have students answer several questions on a 9-point scale - **Analysis**: Compare total cognitive load scores between groups, lower scores indicate smoother learning process

Situational Interest: - Indicator: Immediate interest level - **Measurement Method**: After learning, directly ask: "How interesting do you find the learning content just covered?" (using 1-5 point Likert scale) - **Analysis**: Compare average interest scores between groups

4. Subjective Experience and Satisfaction   Lesson Plan Satisfaction Questionnaire: - Indicator: Satisfaction scale scores - **Measurement Method**: Use a questionnaire with multiple items, having students evaluate the clarity, usefulness, attractiveness, etc. of lesson plans - **Analysis**: Calculate average scores for each dimension and conduct between-group comparisons

Preference Choice: - Indicator: Future usage intention - **Measurement Method**: At the end of the experiment, directly ask students which material they prefer to use in the future - **Analysis**: Count and compare proportions of students choosing different lesson plans (chi-square test)

Data Collection Tools: 1. Pre-test/post-test/delayed post-test questionnaires: Carefully designed standardized questionnaires 2. Observation record forms: Structured forms for recording behavioral indicators 3. Immediate feedback scales: NASA-TLX simplified scale and situational interest single-question scale 4. Satisfaction questionnaire: Short questionnaire with 5-7 items 5. Timer: For recording each student's learning time

Phase III: Qualitative Research - Field Observations and In-depth Interviews

Core Objectives: 1. **Deep Understanding of Context**: Reveal reasons behind numbers, explaining causes of experimental results 2. **Discover Unexpected Insights**: Capture subtle behaviors and attitudes that quantitative questionnaires cannot cover 3. **Insight into Real Needs**: Provide first-hand inspiration for designing truly "usable and user-friendly" localized self-study solutions

Preparation Work: 1. **Ethics First**: Prepare and sign informed consent forms, clearly informing research purposes, data usage, privacy protection measures, and right to withdraw at any time 2. **Tool Preparation**: Observation record forms, interview outlines, notebooks, pens, voice recorders (with permission), cameras (with permission) 3. **Clear Identity**: Inform that the role is "learner" and "observer," not "evaluator," to reduce "Hawthorne effect"

Participatory Observation Guidelines   Observation Focus: Behavior, interaction, environment, emotional responses

Observation Content Checklist:

1. **Learning Habits and Processes:**
   - Pre-class/self-study start: How do they prepare? Do they actively preview? How do they obtain materials?
   - Note-taking methods: Do they copy from blackboard/screen, or have their own methods (like underlining, drawing, summarizing)? Where do they write notes (dedicated notebooks, books, scrap paper)?
   - When encountering difficulties: What's the first reaction? (staring blankly, flipping through books, asking desk mates, asking teachers, giving up directly) How do they express questions?
   - Tool usage: Besides textbooks, what else do they use? Reference books? Dictionaries? Phones? How do they use them?
2. **Reactions to Experimental Materials (AI vs. Traditional):**
   - Confusion points: Record specifically which knowledge point or sentence caused confusion
   - Excitement points/interest points: Record what content sparked interest
   - Operational difficulties: Observe if they get stuck on interface navigation? Do they get distracted due to device lag or low battery?
3. **Social Interaction Patterns:**
   - Is learning isolated or collaborative? How do they discuss problems?
   - Student-teacher interaction patterns
4. **Environment and Context:**
   - Classroom lighting, noise, desk and chair layout
   - Is electronic device charging convenient? How is network signal?

Observation Methods: - "Umbrella" observation: First conduct overall scanning to understand overall class atmosphere - "Focus" observation: Select 3-5 representative students for 15-minute interval tracking records - Momentary sampling: Every 5 minutes, quickly record current moment behaviors of specific students

Observation Record Form Template:

Time	Observed Behavior/Event (Objective Description)	My Interpretation/Questions (Subjective Thinking)	Possible Corresponding Research Questions
14:05	Student A saw the animated illustration in the lesson plan, nudged Student B with elbow, pointed at screen, whispered "Wow, this is cool"	Dynamic visual content effectively stimulates interest. Traditional lesson plans lack this element	AI lesson plans' advantages in boosting interest?
14:15	Student C stayed at page 3 exercises for over 5 minutes, constantly erasing and rewriting, finally sighed and put down pen	This question might be too difficult, or explanation insufficient. Clear frustration. Need to ask during interview	Is AI lesson plan's difficulty gradient setting reasonable?
14:30	Over half the students tried clicking on images in printed lesson plan, seemingly expecting interactive effects	Students are already accustomed to digital media interactivity, paper materials may seem "rigid"	How to combine offline and online forms?

Semi-structured Interview Guidelines　Core Principles: Ask more open-ended "why" and "how" questions, avoid leading questions, create relaxed, trusting atmosphere

Student Interview Outline:

1. **Background and Resource Access:**
   - "Do you have computers or tablets at home that can be used for learning? Who mainly uses them?"
   - "What do you usually do with your phone? Do you use it to look up study materials? How?"
   - "When you encounter homework problems, besides asking teachers and classmates, what else do you do?"
2. **Learning Experience and Difficulties:**
   - "For today's new (AI) material, which part did you find most difficult? Why?"
   - "Was there any part that made you think 'Oh, that's how it is' or found interesting?"
   - "Compared to lesson plans teachers usually give, what do you think is the biggest difference? Which do you prefer? Why?"
3. **Imagination and Preferences:**
   - "If you were to design a tool to help you self-study, what would you want it to look like?"

- "What functions would you hope it has?"

Teacher Interview Outline:

1. **Teaching Practice:**
   - "How do you usually prepare lessons and lesson plans/study guides? What resources do you typically reference?"
   - "In your view, what are the biggest difficulties students face in self-study?"
2. **Technology Attitudes and Challenges:**
   - "How do you view AI technology assisting teaching? What expectations and concerns do you have?"
   - "What practical difficulties do you encounter using digital technology in teaching?"
3. **Feedback on Experiments:**
   - "You observed students using these materials, what impressed you most?"
   - "Where do you think AI-generated lesson plans might really help you? Where might not be very applicable?"

Artifact Collection and Analysis Collection Content: Notes, draft papers, homework produced by students during experiments

Analysis Methods: - **Content**: What did they record? Key points, example questions, or their own summaries? - **Structure**: Are notes organized? Can they reflect their thinking logic? - **Interaction with Materials**: Did they do extensive marking, annotation on materials?

Daily Field Reflection: After each day, spend 30 minutes answering these questions: 1. What was the biggest surprise today? 2. Were my main assumptions challenged? 3. Did I overlook any group or perspective? 4. How should I adjust tomorrow's observations and interviews?

Phase IV: Comprehensive Analysis and Product Design (1-2 weeks after research)

Main Tasks: Self-study manual & Platform/website/manual prototype

Methods: 1. **Data Triangulation**: Cross-validate quantitative data with qualitative data for comprehensive analysis, explaining "why" such results were produced 2. **Design Thinking Workshop**: Invite some students and teachers to brainstorm what ideal self-study tools should look like based on discovered needs and difficulties 3. **Output Results**: - **Field Research Report**: Detailed elaboration of research findings, conclusions, and recommendations - **"Low Resource Dependency" Self-study Manual Prototype**: Imitate Khan Academy style but fully consider Bijie's actual situation: - Offline priority: Content can be printed into booklets or support offline download in mobile APP form - Lightweight: Compressed images and videos to reduce traffic consumption

- Extremely simple operation: Clean interface, clear steps, lowering usage threshold - Localized cases: Integrate local student-familiar contexts and examples in example questions and explanations - **Localization Recommendations**: Analyze feasibility of directly transplanting high-end platforms, propose how to take their essence while removing dross, achieving dimensional reduction application strategies

III. Timeline

Week	Phase	Main Tasks
Week 1	Preparation and Pre-research	Contact schools, obtain permission, prepare materials, ethics review
Week 2	Quantitative Experiments	Implement pre-test, intervention, post-test, collect quantitative data
Week 3	Field Observations	Conduct classroom observations, carry out student/teacher interviews
Week 4	Data Analysis	Data organization, statistical analysis, interview transcription
Week 5-6	Report Writing and Design	Synthesize all data, write report, design self-study manual prototype

IV. Expected Outcomes

1. **Academic Outcomes**: A complete field research report that can be used for course assignments, academic conferences, or journal publications
2. **Practical Outcomes**: A field-validated "AI-assisted lesson plan" application model and localized self-study manual prototype applicable to resource-limited areas
3. **Social Value**: Provide empirical evidence and implementation references for educational technology companies, non-profit organizations, and government departments promoting educational technology in similar areas

V. Potential Challenges and Responses

Challenge 1: Difficulty in School Access - **Response**: Connect through local education bureaus, Communist Youth League, university teaching support associations, emphasizing research's public welfare nature and value to schools

Challenge 2: Extremely Poor Electronic Devices and Network Conditions - **Response**: Prepare offline solutions as backup (such as printed lesson plans, videos stored on local computers). This is exactly the "difficulty" that research needs to focus on

Challenge 3: Low Student/Teacher Participation - **Response**: Design

interesting learning content and interactive sessions; prepare some small gifts (stationery, etc.) as thanks

Challenge 4: Cultural Differences and Understanding Deviations - Response: Find a local person as guide or translator; maintain open and humble learning attitude, avoid preconceptions

VI. Required Resources and Budget

Human Resources: 1-2 researchers, possible local coordinator or assistant

Material Resources: Test questionnaires, interview outlines, notebooks, voice recorders (with permission), thank you gifts

Technical Resources: Laptops, electronic devices for testing (if schools cannot provide), statistical analysis software (such as SPSS, Python, R)

Budget: Including transportation, accommodation, material printing, gifts, possible service fees, etc.