Appendix D

Implementation Guide for Teacher Educators: Integrating AI-Assisted Lesson Planning

This appendix provides practical guidance for teacher educators who wish to incorporate AI-assisted lesson planning into their courses. Recommendations are drawn from findings of the present study and organized around common implementation considerations.

D.1. Sample AI Prompts: Effective vs. Ineffective

Participants' experiences revealed that prompt specificity was the single most important factor in generating useful AI output. Table D1 presents examples illustrating the relationship between prompt quality and output utility.

Table D1. Prompt Engineering Examples for AI-Assisted Lesson Planning

Prompt Type	Example	Typical AI Output	Analysis
Ineffective: Too broad	"Write a 5E lesson plan about fractions and science for 3rd grade."	A complete but generic lesson plan covering multiple standards without clear focus; may exceed a single class period.	Lacks specificity regarding which standards, what aspect of fractions, what science topic, and what student population. Participants reported: "My prompts were too broad, resulting in entire lesson plans instead of the specific section I needed."
Ineffective: Too vague	"Give me some ideas for teaching math and science together."	A general list of topic suggestions without pedagogical structure or standards alignment.	Missing grade level, standards, instructional framework, and learner context.

Prompt Type	Example	Typical AI Output	Analysis
Effective: Phase-specific	"Generate three Explore activities for a 3rd-grade lesson integrating Ohio Math Standard 3.NF.1 (understanding fractions as parts of a whole) with Ohio Science Standard 3.ESS2.1 (representing data in tables and graphs). Activities should involve hands-on data collection and take no more than 20 minutes each."	Focused, standards-aligned activities with realistic time frames that can be directly evaluated and adapted.	Specifies grade level, exact standards, the target 5E phase, activity type, and time constraints.
Effective: Differentiation-focused	"For the Elaborate phase of a 4th-grade lesson on multiplicative comparison and force/motion, suggest two extension activities for advanced learners and two scaffolded alternatives for students still developing multiplication fluency. Include specific materials needed."	Tiered activities with concrete support structures and materials lists.	Targets a specific 5E phase, identifies learner populations, and requests practical implementation details.
Effective: Iterative refinement	Initial: "Create an Engage activity for 5th-grade fractions and ecosystems." Follow-up: "The activity you suggested would take too long for a 10-minute opener. Revise it to a 5-minute warm-up using a real-world scenario about measuring rainfall in a local ecosystem."	Revised activity that is time-appropriate and contextually grounded.	The follow-up identifies a specific problem (timing) and provides clear constraints for revision, modeling the iterative process participants found most productive.

D.2. AI Output Quality Assurance Checklist

Based on the quality concerns participants identified, the following checklist provides a structured approach to evaluating AI-generated lesson plan components.

Table D2. Quality Assurance Checklist for AI-Generated Lesson Content

Criterion	Guiding Questions	Common AI Limitations Identified in This Study
Standards Alignment	Does the content address the specified standards? Are both mathematics and science standards treated with equal depth and rigor?	AI sometimes emphasized one subject area over the other: "AI could give more information on math, rather than the science portion or vice versa." *(Participant 7)*
Time Feasibility	Is the proposed activity realistic for the allocated class period? Does it account for transitions, materials distribution, and cleanup?	"Some ideas went too deep and would take almost 45 minutes to cover what should have been addressed in 30 minutes." *(Participant 7)*
Grade-Level Appropriateness	Are the content complexity, vocabulary, and task demands appropriate for the target grade?	AI occasionally generated content exceeding the conceptual level appropriate for elementary students.
Differentiation Adequacy	Are specific accommodations included for advanced learners, struggling learners, ELLs, and students with IEPs? Are accommodations concrete rather than generic?	"AI rarely included modifications we need to incorporate daily" *(Participant 15)*; "AI tools might not take into account the needs of ELLs or students with specific learning disabilities." *(Participant 18)*
Practical Feasibility	Are the suggested materials, technologies, and classroom arrangements available in a typical elementary setting?	"AI gives more of idealistic or imaginative ideas that may not translate well to actual classroom implementation." *(Participant 21)*

Criterion	Guiding Questions	Common AI Limitations Identified in This Study
Integration Authenticity	Do mathematics and science connect meaningfully throughout the lesson, or is one subject treated as an add-on to the other?	"The AI-assisted plan seemed to keep subjects separate. It had me focusing on science until the final step, where we added the math portion." *(Participant 15)*
Conceptual Accuracy	Is the mathematical and scientific content accurate? Are representations (graphs, diagrams, models) correct and appropriate?	Although not frequently reported in the present study, AI hallucinations in STEM content remain a well-documented concern (Gregorcic & Pendrill, 2023; Kortemeyer, 2023).

D.3. Common Challenges and Recommended Responses

Table D3. Anticipated Challenges in AI-Assisted Lesson Planning Instruction

Challenge	Description	Recommended Response
"AI is cheating" resistance	Some preservice teachers may view AI use as undermining the development of professional skills.	Frame AI as a collaborative partner rather than a replacement. Use structured comparison tasks (traditional vs. AI-assisted) to allow participants to experience both approaches and form their own conclusions. Emphasize that evaluating and adapting AI output requires substantial professional expertise.
Over-reliance on AI output	Some preservice teachers may accept AI-generated content without critical evaluation, incorporating it directly into lesson plans.	Require explicit documentation of all modifications made to AI output and written justifications for each change. Use peer review of AI-assisted lesson plans to develop critical evaluation skills collaboratively.
Prompt engineering frustration	Initial prompts often produce generic or overwhelming outputs, leading to frustration and disengagement.	Begin with structured prompt templates (see Table D1), then gradually transition toward open-ended prompting. Teach prompt engineering as an iterative process and model the cycle of prompting, evaluating, and refining.
Uneven platform experiences	Participants may have markedly different experiences depending on their assigned or chosen AI platform.	Expose preservice teachers to multiple platforms. Discuss platform differences explicitly and guide the development of hybrid strategies that leverage complementary platform strengths.
Inadequate AI-generated differentiation	AI-produced accommodations may be generic and insufficiently tailored to specific learner populations.	Require participants to evaluate AI-generated accommodations against specific case-study student profiles with defined characteristics (e.g., a student with dyscalculia, an ELL at a specific proficiency level). Assess whether AI suggestions would be practically effective for each profile.

D.4. Suggested Course Integration Timeline

Based on the procedures used in the present study, the following sequence is recommended for integrating AI-assisted lesson planning within a methods or pedagogy course.

Week	Focus	Key Activities
1–2	Traditional planning foundation	Participants develop integrated lesson plans using traditional methods to establish a baseline for subsequent comparison.
3	AI literacy and prompt engineering	Introduction to AI tools and their educational applications; guided prompt engineering exercises using examples from Table D1; discussion of Critical AI Literacy concepts.
4–5	AI-assisted planning with scaffolding	Participants develop parallel lesson plans on the same topic using AI tools; apply a quality assurance checklist (Table D2) to all AI-generated content; document prompt iterations and modifications.
6	Comparative reflection and evaluation	Structured reflection using prompts from Appendix C; peer review of both traditional and AI-assisted plans; facilitated discussion of professional identity implications and future AI integration strategies.