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Using GAI for Lesson Planning in Teacher Education: Connecting Content Knowledge to Psycho-pedagogical Theories

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Abstract

Generative artificial intelligence (GAI) is a recent technology with valuable contributions to many educational fields, including initial and continuing teacher education. An essential component of teacher training is related to lesson planning, namely the step-by-step anticipation of the stages of educational actions, integrating strategic decisions about what students will learn and how they will learn. Developing lesson planning skills is a complex process that takes place over years of initial and continuing training, through theoretical courses and consistent teaching practicum. The major goal of this article is to present prompting-engineering good practices that contribute to innovative and relevant lesson planning. Access through GAI to a huge amount of theoretical data offers the unique opportunity to facilitate the construction of lesson plans according to the many existing psycho-pedagogical frameworks from the research literature. Psycho-pedagogical models and theories can be quickly accessed, and GAI offers the unique opportunity to generate lesson scenarios taking into account both psycho-pedagogical and disciplinary knowledge in an explicit manner.

Keywords: Generative artificial intelligence (GAI); lesson planning; prompting engineering

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1. Introduction

Lim et al. (2023) define Generative Artificial Intelligence (GAI) as a technology that uses deep learning models to generate content similar to that delivered by humans (images, words). GAI models, such as ChatGPT or Bard, are known as Large Language Models (LLMs) and are trained on massive bodies of textual data. A different method, diffusion, is used to generate images with models trained on massive collections of image data, including works of art. The capabilities of these systems are likely to change drastically in the coming years (Lim et al., 2023).

The educational benefits of GAI are currently an area of interest. Two combined components make enormous advantages possible (Yu & Guo 2023): a) the dialogic and interactivity component, relating to the ability to formulate questions and provide chains of answers, as in a real conversation between two human beings, adapting on the fly and generating increasingly complex solutions, according to the questions asked; b) the resolutive component, generating diverse solutions for problems in numerous fields. These components are supported by several resources and techniques used in their construction (Yu & Guo, 2023):

- Machine learning techniques, a technology that allows learning automatically from data;
- Deep learning techniques that make it possible to discover complex patterns and rules through multi-layer neural networks;
- Natural language processing techniques include technologies that simulate human language skills;
- Image processing techniques.

Based on these components, several advantages are foreseen: an extensive knowledge base, fast real-time response, huge work capacity/productivity, and the possibility of going step by step to improve responses. The areas of teacher education in which GAI can make valuable contributions are: AI as a substitute for teachers; AI as teaching assistants; AI as simulated students and pupils. Kim et al. (2020) explored students' perceptions of AI-based teaching assistants. The results indicate that the perceived usefulness of an AI-based teaching assistant and the perceived ease of communication positively predict favorable attitudes toward using a teaching assistant. Markel et al. (2023) used GPTeach, an interactive teacher training chat that allows beginning teachers to practice with simulated students. GPTeach was recently implemented in the teacher training component of an online course with over 800 beginning teachers.

The main objective of this article is to identify the best ways to use GAI to write prompts that support the creation of lesson plans for teachers. In this sense, we can separate this main objective into two secondary objectives: documenting the most well-known theories about prompt engineering in education; exemplifying the use of GAI on lesson sequences from different school subjects, highlighting the connection between psycho-pedagogical theories and prompt engineering requirements.

To achieve the first secondary objective, we inventoried the specialized literature, extremely recent, in the field of prompt engineering. Regarding the second objective, we relied on the exploration of some famous theories about didactic design in general, but also lesson design, or even learning theories. We intended to highlight that numerous theories that teachers and future teachers study in initial and continuing education can concretely and clearly support lesson design. To achieve this goal, we used the most famous chatbot, namely Chat-GPT, which can achieve in a short time the combination of these theories and the writing of lesson plans. The model we relied on to write prompts appropriate for lesson plans is CODE-PLAN (König et al., 2021). This model was our choice because it is both comprehensive in areas of lesson preparation and also flexible, providing many examples. A strong motivation for this exploration consists of the implementation of scientifically documented teaching activities, based on the numerous contents studied in initial and continuing education. What good are these theories, models if they

are too rarely applied in the classroom? Very often, we hear the argument that teachers do not find ways to translate pedagogical theories into practice, that these theories are forgotten and useless, beyond passing exams.

2. Prompt Engineering for teachers

Since interactivity is the keynote, the process of formulating prompts to ChatGPT is crucial. Prompt engineering is defined as the process of designing, refining, and optimizing input prompts to effectively communicate user intent to a GAI model such as ChatGPT (Ekin, 2023). Useful frameworks recommended are below.

Table 1. Frameworks for Prompt Engineering

Ekin (2023)
- Clear and specific instructions ("Describe the order of the groups in the periodic table of elements.");
- Using explicit constraints, such as format, length, or scope ("Summarize the main ideas of ... in three sentences");
- Using explicit constraints, such as format, length, or scope ("Explain the difference between X and Y using Z and T as examples");
- Using System 1 (with quick, intuitive answers) and System 2 questions (with deliberate, analytical, or complex problem-solving answers).

Liu (2023)
- Use the R T R I Model (Role, Task, Requirements, Instructions);
- Use two-step responses, starting from Bloom's Taxonomy, avoiding focusing on recall or lower-level skills.
  1. Ask GAI to help you understand Bloom's Taxonomy.
  2. Request specific tasks based on the hierarchy of skills in Bloom's Taxonomy.
- Use analogies and concrete examples ("You are a university teacher. Provide three creative analogies to explain …");
- *Use different perspectives:* ("Provide three different perspectives on the…").

Park & Choo (2024): IDEA
- **I**nclude essential PARTS: Persona (the role); Aim (define the goal); Recipients (characterize the audience); Theme (analyse the style, restrictions, and any required items); Structure (formal elements of the text as length, type, and number of paragraphs).
- **D**evelop with CLEAR prompts: Concise; Logical (well organized and understandable); Explicit (concrete and exact); Adaptive (personalized and adapted); Restrictive (limited and appropriate to the domain).
- **E**valuate outputs and REFINE prompts: Rephrase the main elements; Experiment with context and examples; Feedback loop; Inquiry questions; Navigate by iterations; Evaluate and verify outputs;
- **A**pply with accountability: Aware of potential limitations; Use a responsibility checklist.

3. Lesson planning with ChatGPT

Curriculum design refers to anticipating the components of educational actions, to strategically deciding what their students will learn and how they will learn. Building lesson plans based on automated methods is not a recent topic. Since the seventies, a series of initiatives have been advanced. In the 1990s, the use of the notion of AI and advanced interactive technologies in the design, development, and delivery of military training information systems began (Tennyson & Spector, 1995). The purpose of an automated design system is to guide the design of a

curriculum project, starting from teaching methods to other components, such as organizational forms, implementation modalities, and evaluation strategies (Reigeluth apud Spector, Polson & Muraida,1993). It is good to know that automated design does not replace the curriculum content expert.

GAI can ensure the rapid connection of psychological theories with didactic design and actual teaching. It is a complicated task, rarely accomplished by prospective teachers or even experienced teachers. Often, theories remain "in a drawer", closed for good after passing the exams. A crucial finding is that teachers do not plan their lessons according to the formal guidelines and specific frameworks used in teacher education, thus invalidating the efforts made in initial teacher education programs (Clark & Peterson, 1986; Kang, 2017). An important goal of Teacher Education programs is to help prospective teachers develop a systematic process of planning instruction and to embrace the concept of writing instructional plans (Baylor & Kitsantas, 2005). Numerous theoretical frameworks for lesson planning have been developed in recent decades in order to integrate the most valuable research on the nature of effective learning of different content. Even though these theories are taught in initial training courses, they find little place in future teachers' lesson planning or when they become classroom teachers (Kang, 2017).

The development of didactic design skills for future teachers is a complex process and is hampered by a multitude of obstacles, both internal and external. We argue that access through GAI to a huge amount of theoretical data allows a unique opportunity to facilitate the construction of lesson plans according to existing theoretical frameworks. All these approaches, models, and theories can be used for good lesson planning by student teachers, and GAI offers a unique opportunity to generate lesson plans taking into account psycho-pedagogical knowledge and content knowledge.

In the following, we will use the CODE-PLAN (Cognitive Demands of Lesson Planning model from König et al., 2021) to identify the cognitive needs imposed by the teaching design. In addition, we will start by explaining these demands to apply GAI tools to specific disciplinary content. The CODE-PLAN model (König et al., 2021) places the following cognitive requirements at the center of lesson planning.

Establishing and refining lesson stages refers to the appropriate sequences that serve as tools and activity patterns for the content. Good teaching is carefully planned teaching, generated by strategies discovered in various theories. Connecting psychological theories with pedagogical design is a difficult task, but it must be done. By simplifying the bureaucratic phases of lesson plan writing, GAI provides time for preservice teachers to engage in reflection and discovery. It is well known that in the teaching profession, writing lesson plans takes a lot of time. It is not at all a simple activity, especially when you are a future teacher. To counteract this, several general theoretical models have been developed over time. Following a chronological axis, we can name the following instructional design models: Nine Events of Instruction (Gagne, 1965); Direct Instructional Model (Hunter, apud Steward, Martin, Burns & Bush, 2010), Backward Design Model (Wiggins & Tighe, 2005). In an extremely fast time, GAI can make the connection between any teaching and learning theory and its transposition into a lesson plan. Very useful and relevant are also the frameworks proposed by classic authors such as Benjamin Bloom (apud Frumos, 2008), Robert Marzano (2014), John Hattie (2015), Howard Gardner (2006), etc. We can group these models according to a series of directions, so that some fall into the category of traditional models, others into constructivist models, with an emphasis on discovery and problem solving. Also, several models refer to planning in certain fields of disciplines. For example, in the field of science, the 5E model is recognized (Engage, Explore, Explain, Elaborate, and Evaluate, Bybee et al. 2006).

Content transformation refers to the translation of content into forms that are accessible to learners. This transformation involves critically examining and selecting instructional materials, identifying key ideas and how they might best be represented, such as through examples or

analogies. One of the most analytical classifications of teachers' knowledge belongs to Shulman (1987). All the categories of knowledge established by Shulman (knowledge about curriculum, knowledge about pedagogical content, knowledge about students, content knowledge, general pedagogical knowledge) can be expanded with the help of GAI.

Task creation refers to the actual writing of content and objectives for a class or group of students. More specifically, it refers to exemplifying objectives, content, and work materials for a group of children at a specific time and in a specific setting (Kang, 2017). The teacher will take into account certain levels of difficulty in different dimensions, adapting differently to the needs of students through differentiated strategies (Dack, 2018; Tomlinson, 2001, 2015).

Adapting to learning dispositions takes into account the social context and prior knowledge of students (Konig et al., 2020). The teacher must reflect on how learning tasks are related to each other over time, so that learners are guided in their "zone of proximal development" (Vygotsky, 1978, p. 84).

Clarity of objectives refers to the requirement that teachers formulate precise learning objectives for students so that they can consider them as firm benchmarks in the individual learning process. Theories that have influenced the writing of educational objectives are those developed by Bloom (1982) and Mager & Peatt (1962).

Contextualizing the content unit refers to the design of references in the lesson plan that ensure the integration of the lesson into a thematic unit, by emphasizing the relevant theme within the unit, for example. These references ensure the linking of lessons in a chain and allow cumulative learning by students.

Table 2. Lessons planning connecting content knowledge and psycho-pedagogical theories

CODE-PLAN stages (König et al., 2021)	Prompt-engineering examples connecting content knowledge and psycho-pedagogical theories
Establishing and refining lesson stages	• I am a beginning teacher who needs a lesson plan on karyotype, normal karyotype, trisomy 21, and other genetic diseases. Use the levels of Bloom's Taxonomy to structure the activities. Please describe several activities for the application stage of Bloom's theory. • I am a teacher who needs a lesson plan for high school students about Ancient Greece. Uses learning strategies from Howard Gardner's theory of multiple intelligences. • I am a beginning teacher who needs a lesson plan about the Capitals of Europe. Uses Hattie's strategies. • I am a high-school teacher who needs a lesson plan about the First World War in Europe. Uses Marzano teaching strategies.
Content transformation (using metaphors and analogies)	• Please give me examples of interdisciplinary connections that I can make as a high school history teacher teaching about World War I. • I am a high school psychology teacher, and I want to teach about the concept of personality using metaphors and analogies. Please help me.
Task creation (differentiated teaching)	• I am a teacher for 11-year-olds. There are students with different levels of readiness in the class. Help me teach them about the important lines in the isosceles triangle in a differentiated way, from simple to complex. • I am a geography teacher and I want to teach high school students about the continent of Asia, taking into account their different learning styles. Please help me.

Adapting to learning dispositions	• I want to explain inertia to 7-year-olds. Can you help me? • Help me teach photosynthesis to 9-year-olds. Please explain this process to me in a simple and clear way.
Clarity of objectives	• I teach physics to 12-year-olds. Formulate the objectives of a lesson on density using Bloom's Taxonomy. Structure classroom activities based on these objectives. • Formulate the objectives of a philosophy lesson on utilitarianism according to Robert Mager's framework.
Contextualizing the content	• I am a psychology teacher and I want to explain to 16-year-old students the place that Sigmund Freud occupies in psychology by making comparisons between him and other famous psychologists. • I am a high school history teacher, and I want to design a review plan for the topic of World War II. Help me structure this plan by integrating the most important ideas about this event.

Teachers and future teachers can use the good practices from the previous table by following an agreed lesson plan template, and then they will refine each pedagogical area from the CODE_Plan with stand-alone questions. Depending on the situation, they will insist on the area that interests them, having a dialogue with ChatGPT that encompasses previous progress. The advantages of writing the requests appropriately, as can be seen, are multiple: suitability to the stages of the lesson, to the age of the students, and to socio-psychological contextual variables, scientific documentation, exploration of numerous theories, methods, and pedagogical strategies. In a word, GAI will explicitly and quickly support Pedagogical Content Knowledge (PCK). It is unlikely that a teacher will be able to combine so many resources alone, without help, so many resources in such a short time. What a chatbot actually offers is a brainstorming of answers from which the teacher will make the best decision.

Teachers' professional expertise involves the simultaneous bringing together of content knowledge and pedagogical knowledge (Shulman, 1987). By combining these two categories, teachers actually arrive at Pedagogical Content Knowledge (PCK), namely, the best teaching strategies that make learning material easy to understand. Also, other researchers as van den Berg & du Plessis (2023), Karaman (2024), and Baytak (2024), have demonstrated that, beyond the necessary precautions, writing lesson plans with AI is extremely useful. Peikos & Stavrou (2025) provided evidence supporting that incorporating PCK elements into requests could improve the quality of AI-generated lesson plans.

Conclusions

Teacher education programs around the world include courses and practicum aimed at developing teachers' ability to write lesson plans. This is an essential skill in the teaching profession, as it lays the groundwork for student progress. On the other hand, an increasing number of recent studies highlight the benefits that teachers can achieve when they turn to GAI for lesson planning. In this article, we want to emphasize that a step forward in lesson planning could be achieved by incorporating requests into prompts that take into account the names of famous theoretical frameworks. We do not claim that ChatGPT can provide fully written lesson plans in the absence of teachers' professional judgment, but the successive refinement of requests can lead to extremely valuable ideas. This is just one of the possibilities of using GAI in teachers' work. Many studies refer to other facets of lesson design with GAI, arousing the interest of educators around the world. As we can see from this study, the solutions offered by GAI are

nuanced and can prove to be truly useful. Consequently, the use of GAI in lesson design is a topic that can no longer be ignored in teacher training.

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