Artificial Intelligence-Enhanced Lesson Design (AI-ELD) Process

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Contents

Short Biography

I am an educator from Singapore. I chose the teaching profession because I cherish interacting with children and assisting them in their journey to become independent and mature adults. Since beginning my teaching career 14 years ago, I have enjoyed every moment.

I specialize in teaching elementary math and science, primarily to students in grades three to six. Apart from my duties as a classroom teacher, I also serve as the Head of Department for Information and Communications Technology (HOD ICT) at my school. In this capacity, I am responsible for overseeing the procurement and management of our information technology (IT) infrastructure. Moreover, I facilitate professional development opportunities for fellow educators through workshops and mentoring sessions.
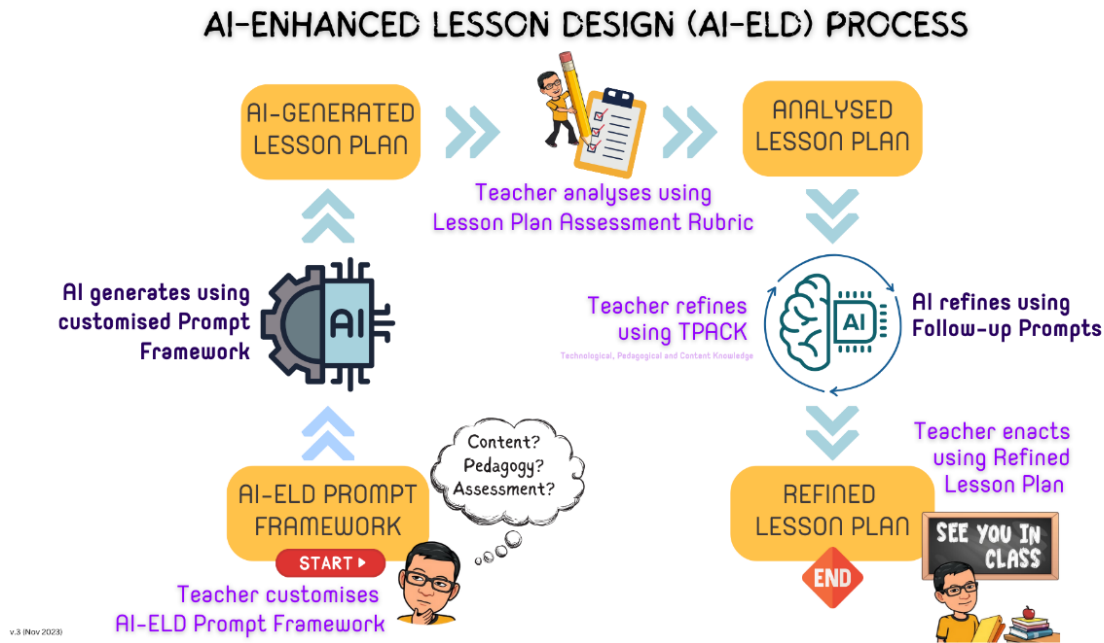
One of my passions is exploring and understanding the most effective ways to integrate edtech tools with new or existing pedagogies. This approach aids me in fostering a participatory, connected, and reflective classroom environment, which is essential in nurturing future-ready learners. I take pleasure in sharing both my successes and setbacks in integrating technology into my lessons with educators, not just in Singapore but globally. I've discovered that sharing my experiences often deepens my own understanding of what I've accomplished.

Executive Summary

This research project aims to create a process to guide educators on how to use artificial intelligence (AI) to enhance the process of lesson designing by synergizing the computational capabilities of AI with the professional wisdom of educators to create meaningful learning experiences for students (Figure 1). The term "AI-enhanced" is significant because it doesn't

Figure 1

Artificial Intelligence-Enhanced Lesson Design (AI-ELD) Process

AI-ENHANCED LESSON DESIGN (AI-ELD) PROCESS

AI-GENERATED LESSON PLAN

Teacher analyses using Lesson Plan Assessment Rubric

ANALYSED LESSON PLAN

AI generates using customised Prompt Framework

Teacher refines using TPACK
Technological, Pedagogical and Content Knowledge

AI refines using Follow-up Prompts

Content? Pedagogy? Assessment?

Teacher enacts using Refined Lesson Plan

AI-ELD PROMPT FRAMEWORK
START ►

REFINED LESSON PLAN
END

SEE YOU IN CLASS

Teacher customises AI-ELD Prompt Framework

v.3 (Nov 2023)

involve replacing educators in the lesson planning process. AI can generate a lesson plan, but it cannot create an effective one because it lacks an understanding of our students' contexts and lacks a strong relationship with our students. These aspects are crucial for customizing a lesson plan to meet our students' needs and facilitate their optimal learning. Nevertheless, AI can serve as a valuable starting point in the planning process and offer inspiration to educators.

The process is divided into three parts. First, the educator customizes the AI-ELD prompt framework according to the lesson's context and requirements. Then, they input these customized prompts into an AI system (e.g., ChatGPT or Bard) to generate a lesson plan. The educator then uses the Lesson Plan Assessment Rubric to analyze the AI-generated lesson plan, pinpointing its strengths and identifying potential areas for growth. Finally, the educator refines the lesson plan by leveraging both their own technological, pedagogical, and content knowledge (TPACK) and

the capabilities of AI, utilizing follow-up prompts for further development. The result is a refined lesson plan that not only meets the needs of the students, but also creates the meaningful learning experiences that our students deserve.

Overview and Explanation of Relevance

Lesson planning is the cornerstone of effective teaching (Ashcraft, 2014). Traditionally, a cornerstone was the first stone placed at the bottom corner of a building, with all subsequent stones laid in reference to it. In the same way, lesson planning lays the foundation for a deep and meaningful learning experience for our students. However, many educators feel that lesson planning is challenging and time consuming. Is there a better way to do this important but difficult piece of work? The answer is an emphatic yes! AI offers educators a way to reimagine the process of designing meaningful learning experiences for our students.

Instead of relying solely on our pre-existing ideas and knowledge for lesson planning, which can be limited at times, we can turn to AI. With access to vast datasets, AI can suggest potential lesson activities, questions, and appropriate tech tools. Although AI alone cannot create an effective lesson plan, it can be a launchpad to begin the planning process and provide inspiration. Educators can then apply their critical and creative thinking, combined with their TPACK (Mishra & Koehler, 2005), to further refine the plan. This synergy results in an effective lesson that facilitates deep and meaningful learning for our students. Dr. Brian Sharp, Professor of Mathematics, and Dr. Holly Rougeaux, Assistant Professor of Mathematics, both at Indiana University of Pennsylvania (IUP) observed that as pre-service teachers refined their lesson-planning abilities using ChatGPT, the focus shifted from crafting lesson plans to evaluating and refining those generated by AI (Rougeaux & Sharp, 2023). In the same way, AI enables us to complement our human wisdom with artificial intelligence.

Background Section

In the post-pandemic era, Singapore's education system has shifted its focus towards e-Pedagogy, recognizing the pivotal role that technology plays in modern teaching and learning environments. Central to this transition is the emphasis on designing quality learning experiences that seamlessly integrate technology. Moreover, a significant portion of Singapore's professional development now aims to equip educators with the expertise to create interactive, student-centred learning environments. AI provides educators with an additional tool, empowering them to craft richer learning experiences for their students.

As the HOD of ICT, I am also responsible for overseeing the professional development of educators in e-Pedagogy. Educators often face challenges in designing meaningful learning experiences with technology, primarily due to a lack of knowledge and familiarity with digital tools suited for diverse pedagogies. Consequently, they might resort to using tools they are comfortable with, even if these tools are not the most purposeful for the lesson at hand. Furthermore, many educators are not exposed to innovative pedagogies that can foster richer learning experiences for their students. Traditionally, their primary avenues for improvement have been seeking advice from colleagues or awaiting professional development opportunities. By introducing them to the AI-ELD process, I aim to enable them to harness the expansive knowledge of AI. This would guide them in selecting the most appropriate edtech tools and pedagogies tailored to specific learning outcomes.

Crafting high-quality lesson plans is pivotal to effective teaching. This imaginative process allows educators to merge their content knowledge with an understanding of their students, curriculum requirements, the classroom environment, and the best pedagogical practices to achieve the desired student outcomes (Jensen, 2001). Furthermore, by leveraging the

affordances of educational technology tools, educators can integrate all these elements to provide an optimal learning experience that equips students with the necessary knowledge, skills, attitudes, and values inherent in that lesson. Indeed, the planning phase is instrumental in shaping students' quality learning, and educators must be equipped with skills associated with the TPACK framework (Mishra & Koehler, 2005)

Lesson planning also results in more cohesive lessons (Jensen, 2001). It offers educators a chance to thoughtfully determine their lesson goals, select appropriate activities, sequence them logically, decide on needed resources, estimate duration for each activity, and plan student groupings. Reflecting on the connection between different activities and how current lessons relate to past or upcoming ones makes the learning more impactful for students.

Educators who are well-prepared also tend to be more confident. Their clarity on the sequence of the lesson and preparedness means a smoother class experience, with minimal disruptions like searching through textbooks or making last-minute copies. This preparedness not only bolsters educators' confidence but also earns them more respect from students, fostering a conducive learning environment.

While some educators believe that planning lessons is time-consuming, the effort pays off. Plans can be reused or adapted for future lessons. Many educators maintain archives of past lessons, which serve as valuable references when planning new ones. In essence, investing time in lesson planning now can lead to time savings down the line.

Rougeaux and Sharp (in press) found that getting their pre-service teachers to use AI in lesson planning might lead to reduced time dedicated to teaching lesson plan creation. As preservice teachers master the art of creating lesson plans with AI, the emphasis transitions from

generating plans to assessing and fine-tuning those produced by AI. This could free up substantial time in methods courses, allowing exploration of other vital facets of math instruction. As such, it is evident that utilizing AI to improve the lesson planning process can offer substantial benefits for educators by giving them a leverage in creating exceptionally high-quality lesson plans (Rougeaux & Sharp, in press).

Sunil Ramlochan, an Enterprise AI Specialist from Prompt Engineering Institute, reminds us that "ChatGPT and its comrades have captivated the world, but their real power lies in prompts, not processing" (Ramlochan, 2023b, heading). It would be naïve to expect AI to generate high-quality lesson plans that meet the needs of our students. Even though AI possesses immense computing capabilities, it cannot read minds or discern what is wanted from a simple, one-line command. Only through detailed and well-designed prompts can AI generate a lesson plan tailored to the specific needs of students.

Prompt Engineering for Singapore's Teachers

I initially used the phrase "AI-powered" to describe the process developed to support Singapore teachers' prompt engineering; however, after reading *Learning Evolution: The New era of AI in the Classroom* (Hooker, 2023), I realized that the term "powered" might mislead one into thinking that the AI is the driving force in the lesson plan process, which is not true at all. AI is just another, albeit more powerful, educational technology tool which will enhance the work that we as educators do and will continue to do. AI enhances the design process by providing data-driven insights and automating certain aspects, thereby freeing up educators to focus on what truly matters—knowing their students and designing customized learning experiences that caters to their needs. Therefore, using the phrase "AI-enhanced" to describe the lesson plan work

done here would be more suitable because what I am suggesting is about how AI will enhance the work that educators do (Hooker, 2023).

Engineering Prompts

For this project, I designed the AI-ELD Prompt Framework, drawing inspiration from the prompt recipes of the Prompt Engineering Institute (Ramlochan, 2023a). Prompt recipes are templates created to assist users in formulating effective prompts that can be consistently reused for desired outcomes. These recipes are built around four primary components: task, instructions, context, and parameters/settings. Each recipe provides pre-populated fields while also leaving spaces for users to customize according to their needs.

In addition, I incorporated components from the ACDQ framework, introduced by Jen Bryan, the Co-Founder & Chief Marketing Officer of VelocityGrowth.com. According to Bryan, leveraging the Act-Context-Deep Think-Question (ACDQ) framework is a move to unlock better results from ChatGPT (2023). The framework starts by instructing the AI to "act as an expert". This approach enhances the AI's capability to deliver high-quality information consistent with the norms and expectations of the designated domain. In my context, I hope that by telling AI to act as an expert educator, it will design a lesson of the highest quality. The next stage in the framework involves providing AI with ample context, a principle that aligns with Sunil Ramlochan's recommendations in his prompt recipes article (2023b). Context is crucial for AI to generate outputs that meet user expectations. Following this, we instruct AI to engage in deep thinking. While Jen Bryan (2023) admits she is uncertain about the exact mechanics behind its efficacy, she has observed that prompting the AI to "think deeply" often results in outputs of superior quality compared to when this instruction is omitted (:46). Lastly, the final component

of the ACDQ framework encourages AI to pose questions to the user. This step is designed to garner additional context, thereby enabling the AI to refine and improve its generated responses.

However, despite the use of the ACDQ framework and recommendations from the Prompt Engineering Institute, the results returned varied in quality and applicability. It is well established that the datasets that generative AI draws information from often harbor biases, such as racial or gender biases, leading to the over-representation or under-representation of specific groups, particularly in large datasets (Barocas & Selbst, 2016). I found it particularly evident in the context of Singapore's education system, where there is a probable lack of extensive data that is aligned with Singapore's educational context, norms, and practices. In my research, I noticed that terms that are important within Singapore's education context like "e-Pedagogy," "key applications of technology," and "active learning process" were often misconstrued by AI. Thus, these terms needed to be reworded or explained explicitly to ensure understanding by AI. The use of acronyms should also be avoided, as we cannot be presumed that AI understands their specific meanings.

Assessing Output

The lesson plan assessment rubric was developed with reference to the Ministry of Education (MOE) of Singapore's Educational Technology Pedagogical Scaffold (EdTech PS) (Educational Technology Division [ETD], Ministry of Education, Singapore, 2023). A primary focus in Singapore's education system is the practice of technology-enhanced teaching for active learning. This approach aims to foster a participatory, connected, and reflective classroom environment, preparing students who are future-ready—often referred to as e-Pedagogy. Educators are, therefore, expected to design lessons that incorporate e-Pedagogy. By utilizing the

EdTech PS in developing the assessment rubric, Singaporean educators can effectively gauge AI-generated lesson plans against the standards of the Singapore education system.

In her blog, educator Jennifer Gonzalez, author of the website *Cult of Pedagogy*, describes the pros and cons of holistic, analytic, and single-point rubrics (2014). The most common type of rubric is a holistic rubric in which there are three to five categories or stages of performance with descriptions that specify the attributes found in each level. These levels can be labelled with numerals such as 1 to 4, alphabetic characters such as A to F, or word labels such as beginner, proficient, and exemplary. A holistic rubric helps the user evaluate a process or product. In contrast to a holistic rubric, an analytic rubric breaks down the various characteristics or criteria of a task into distinct parts, each with its own set of performance indicators. This detailed breakdown allows the individual utilizing the rubric, whether the user is an educator, evaluator, or the learner themselves, to define which aspects of the performance or output are strong, meeting, or exceeding expectations, and which ones fall short, necessitating improvement.

A single-point rubric is like an analytic rubric in that it breaks down assessed characteristics or criteria into parts. The difference is that a single-point rubric simply outlines the criteria upon which proficiency is based and does not attempt to list all the ways a student may fail or excel at the task. Jarene Fluckiger (2010) observed an increase in student achievement, particularly where students participated in formulating them and evaluating their assignments using these rubrics. The main advantage of the single-point rubric is that the learner receives more constructive feedback due to the open-ended nature of the strengths and weaknesses evaluation for each criterion.

Using a single-point rubric for the lesson design assessment rubric will allow educators to be more critical in their self-assessment of AI-generated lesson plans. It will allow educators to better analyze the lesson plan to identify the areas to further strengthen or improve upon. The open-ended nature of the single-point rubric also allows educators to collaboratively evaluate and give feedback on lesson plans.

Materials and Methods

To develop and improve the AI-ELD process, I collaborated with Dr. Holly Rougeaux and Dr. Brian Sharp from IUP, who played a crucial role in refining the AI-ELD Prompt Framework based on their own research (in press). I also formed an interest group—the AIEd Planners—with a team of educators from Singapore. They analyzed their own AI-generated lesson plan using the lesson plan assessment rubric to find common strengths or areas for growth that was used to refine the AI-ELD Prompt Framework further. They also piloted the refined lesson plans with their own students to evaluate whether AI indeed was able to enhance the lesson design process. Analysis of these data is crucial, as it remains to be determined whether AI is truly a valuable tool in lesson design. Dr. Sharp and several colleagues from Singapore also contributed suggestions to the lesson plan assessment rubric.

Results

The AI-ELD Prompt Framework is currently at its fourth iteration of refinement based on the feedback from Dr. Brian Sharp, Dr. Holly Rougeaux, colleagues from my school in Singapore, members of the AIEd Planners as well as Jen Bryan and Sunli Ramlochan, who are experts in prompt engineering.

Version #1

After viewing, *The Ultimate Guide to Lesson Design with AI* (Clark & Kary, 2023), I created the first version of the prompt framework (in italics below):

> *Play the role of a [Level] [Subject] teacher in Singapore tasked with creating a detailed [Duration] lesson plan on the topic of [Topic]. Design using the [Pedagogy e.g., CPA, Blended Learning, etc.] and integrate technology to [choose the required KAT i.e. support Assessment for Learning, foster Conceptual Change, provide Differentiation, facilitate Learning Together, develop Metacognition, enable Personalization or Scaffold the learning]*

> *Organize the information in a table with detailed description of activities using Singapore's Active Learning Process of Activate Learning, Promote Thinking and Discussion, Facilitate Demonstration of Learning and Monitor and Provide Feedback.*

> *Column #1 - Duration*

> *Column #2 - Components*

> *Column #3 - Detailed description of activities*

> *Column #4 - Justify your response.*

Design the lesson according to these learning outcomes.

- *Key Concepts: [Insert lesson objectives from syllabus document]*

- *21CC: [Insert 21CC. Refer to 21CC document]*

- *Success Criteria: [Insert success criteria]*

Evidence of Learning: [e.g., Online responses, group discussion and workbook/worksheets]

Resource available: [e.g., iPads, Chromebooks, etc.]

I customized the framework with details of a grade four math lesson on the area of composite figures as shown below in italics:

Play the role of a Primary 4 Math teacher in Singapore tasked with creating a detailed 60-minute lesson plan on the topic of Finding Area of Composite Figures. Design using the Concrete-Pictorial-Abstract (CPA) Approach and integrate technology into the lesson to provide Differentiation, facilitate Learning Together and develop Metacognition.

Generate detailed description of activities of the lesson using the components of Singapore's Active Learning Process of Activate Learning, Promote Thinking and Discussion, Facilitate Demonstration of Learning and Monitor and Provide Feedback. Organize the information in a table.

Column #1 - Duration

Column #2 - Components

Column #3 - Detailed description of activities

Column #4 - Justify your response.

Design the lesson according to these learning outcomes:

Key Concepts: Students will be able to find the area of a composite figure made up of squares and rectangles.

21CC: Communicate and interact with others to share information and ideas.

Success Criteria: Identify the shapes that make up a composite figure. Find the area of the composite figures.

Evidence of Learning: Online responses, group discussion and workbook/worksheets

Resources available: Chromebooks

I tested the prompt framework with ChatGPT 4, ChatGPT 3.5 as well as with Google's Bard AI. Here are the results generated for each tool.

- ChatGPT 4 - https://chat.openai.com/share/f4923b95-b403-4eab-896b-619f8c9ec129

- ChatGPT 3.5 - https://chat.openai.com/share/c22a7fab-9c30-4f99-a18a-3c31ff9bf142

- Bard - https://g.co/bard/share/53e41536f499

I then consulted a colleague at my school, Grace Phang, who is a Senior Teacher for Learning Needs (high ability learners) and a grade 4 math educator, to review the AI-generated results. Together, we arrived at the following conclusions based on those results:

- Key pedagogical terms like 'recap' and 'prior knowledge' were not included.

- Could AI in fact consider the Singaporean context, setting and/or environment when generating the plan?

- While Kahoot! is a good suggestion, it might not be sufficient for assessing students' deeper understanding. This could be due to the limited information provided to AI, such as context, experience, and assessment type. Kahoot! is typically used for knowledge-based questions, which might not adequately evaluate students' conceptual grasp.

- While AI provides a lesson plan basic structure, the lesson plan lacks the depth and detail needed for successful implementation.

- In instances where the type of resources was not explicitly specified in the prompt, such as Chromebooks or iPads, AI often utilized interactive smart boards in the generated lesson plans.

Version #2

Building on the feedback from Version #1 and incorporating Jen Bryan's ACDQ Chat GPT Framework, I refined the framework. Words highlighted in bold reflect changes made from the previous version. The process is italicized below.

__Act as__ a world class [Level] [Subject] teacher in Singapore tasked with creating a detailed [Duration] lesson plan on the topic of [Topic].

Here is the __context__ of my lesson design:

- *Pedagogy: [e.g., concrete, pictorial, abstract (CPA); blended learning; etc.]*

- *Integrate technology to [choose the required Key Applications of Technology (KAT) i.e., support assessment for learning, foster conceptual change, provide differentiation, facilitate learning together, develop metacognition, enable personalisation or scaffold the learning]*

- *Key concepts: [Insert lesson objectives from syllabus document]*

- *21CC: [Insert 21CC. Refer to 21CC document]*

- *Success criteria: [Insert success criteria]*

- *Evidence of learning: [e.g., Online responses, group discussion and workbook/worksheets]*

- *Resource available: [e.g., iPads, Chromebooks, etc.]*

Organize the information in a table with detailed description of activities using

Singapore's Active Learning Processes (i.e., Activate Learning, Promote Thinking and

Discussion, Facilitate Demonstration of Learning and Monitor and Provide Feedback).

Column #1 - Duration

Column #2 - Components

Column #3 - Detailed description of activities

Column #4 - Justify your response

Think deeply to design this lesson. Ask me any questions that are going to be relevant for you to have a better context to design an even better lesson.

Once again, for consistency, I tested the framework using the same grade four math topic of area of composite figures. Using the framework above, this italicized text below is the prompt I engineered:

Act as a world class Primary 4 Math teacher in Singapore tasked with creating a detailed 60 minute lesson plan on the topic of finding area of composite figures.

Here is the context of my lesson design:

- *Pedagogy: Concrete-Pictorial-Abstract (CPA) approach*

- *Integrate technology to provide differentiation, facilitate learning together and develop metacognition*

- *Key concepts: Students will be able to find the area of a composite figure made up of squares and rectangles.*

- *21CC: Communicate and interact with others to share information and ideas*

- *Success criteria: Identify the shapes that make up a composite figure. Find the area of the composite figures.*

- *Evidence of learning: Online responses, group discussion and workbook/worksheets*

- *Resources available: Chromebooks*

Organize the information in a table with detailed description of activities using the components of Singapore's Active Learning Process (i.e., Activate Learning, Promote Thinking and Discussion, Facilitate Demonstration of Learning and Monitor and Provide Feedback).

Column #1 - Duration

Column #2 - Components

Column #3 - Detailed description of activities

Column #4 - Justify your response

Think deeply to design this lesson. Ask me any questions that are going to be relevant for you to have a better context to design an even better lesson.

Here are the results for this version:

- ChatGPT 4 - https://chat.openai.com/share/18dd12a7-2cad-4fb4-afac-9cac423ceb8c

- ChatGPT 3.5 - https://chat.openai.com/share/77de3054-61ea-46c2-9889-1cc0ffe1059d

- Bard - https://g.co/bard/share/71abb4d8214a

This time, I presented my results to Dr. Brian Sharp and Dr. Holly Rougeaux of IUP, and we reached the following conclusions:

- AI was unaware that students already knew how to find the area of squares and rectangles before this lesson.

- The lesson lacked sufficient critical thinking questions.

- Compared to ChatGPT 3.5 and Bard, ChatGPT 4 seems to provide higher quality responses; therefore, I would focus on ChatGPT 4 for the remainder of my project.

- ChatGPT 4 did not produce the exact same lesson even when given an identical prompt.

Version #3

This version builds on the feedback from Dr. Sharp and Dr. Rougeaux. Words highlighted in bold reflect changes made from the previous version.

Act as a world class [Level] [Subject] teacher in Singapore tasked with creating a detailed [Duration] lesson plan on the topic of [Topic].

Here is the context of my lesson design:

- *Pedagogy: [e.g. CPA, blended learning, etc.]*

- *Integrate technology to [choose the required KAT i.e. support Assessment for Learning, foster Conceptual Change, provide Differentiation, facilitate Learning Together, develop Metacognition, enable Personalisation or Scaffold the learning]*

- *Key Concepts: [Insert lesson objectives from syllabus document]*

- *21CC: [Insert 21CC. Refer to 21CC document]*

- *Success Criteria: [Insert success criteria]*

- *Evidence of Learning: [e.g. Online responses, group discussion and workbook/worksheets]*

- *Resource available: [e.g. iPads, Chromebooks, etc.]*

- ***Prerequisite knowledge: [Insert any prerequisite knowledge that students are supposed to know]***

*Organize the information in a table with detailed description of activities **and questions that can promote students' critical thinking** using Singapore's Active Learning Process of Activate Learning, Promote Thinking and Discussion, Facilitate Demonstration of Learning and Monitor and Provide Feedback.*

Column #1 - Duration

Column #2 - Components

Column #3 - Detailed description of activities

Column #4 - Justify your response

Think deeply to design this lesson. Ask me any questions that are going to be relevant for you to have a better context to design an even better lesson.

On September 28, 2023, I met with a group of educators representing various grade levels and subjects. I introduced the prompt framework to them and had them use it to generate a lesson of their choice. The following are key highlights from our discussion:

- ChatGPT's Malay leans more towards Singaporean Malay, while Bing Chat's Malay is closer to Bahasa Indonesia.

- Would substituting the term 'Beginning teacher' for 'Expert or Master teacher' yield a more detailed lesson plan? *(Note: When I adjusted the prompt accordingly, I didn't observe any significant difference in the lesson plan.)*

- Even though the class profile was provided in the prompt, ChatGPT appears unable to differentiate the lesson for various segments of the class.

- Additional follow-up prompts are certainly required to enhance the depth of thinking and planning for the lesson by AI.

Overall, we unanimously agree that while AI-generated lesson plans will have areas for improvement, they offer a valuable starting point for the design process and can be a valuable source of inspiration for educators. These plans can also serve as a basis for discussions to hone our lesson planning knowledge and skills.

Another forward-thinking educator has embarked on a fascinating exploration: harnessing AI to critique existing lesson plans. This marks the promising beginning of her venture - https://docs.google.com/spreadsheets/d/1tHOKStjaZZ8rjldIHUi7pyWgfLI_LvmAyB2TdJ5YbEA/edit#gid=762310934

Version #4 (Current Version)

After reading Sunil Ramlochan's article titled 'Master Prompt Engineering: Prompt Recipes - A Framework for Reusable AI Prompts', I realized that my prompt framework aligned well with the prompt recipe he introduced. I incorporated the framework into the reproducible spreadsheet that Ramlochan shared.

Upon testing this merged version, I observed that putting all the prompts to ChatGPT at one go occasionally resulted in the model not presenting the lesson plan in a table form, even

though this format was specified in the prompt. However, when I divided the prompts into two separate inputs, ChatGPT consistently displayed the lesson plan as a table.

The current version (Figure 2) utilizes a Google Spreadsheet to compile the prompts into two separate paragraphs, allowing users to copy and paste them into AI tools such as ChatGPT. However, Dr. Sharp and I recognize that this method may not be user-friendly, particularly for those with limited experience or expertise in using Google Spreadsheets. Consequently, we are actively seeking a more accessible approach that will enable educators to easily customize the AI-ELD Prompt Framework for input into AI systems.

Figure 2

AI-ELD Prompt Framework

Task	Role	You must act as an expert teacher teaching in **Singapore**
	Command	I will provide you with details about my lesson, and it will be your job to think deeply and write a detailed lesson plan. I want you to design a lesson where students make sense of information and knowledge to achieve deep understanding through interacting with content, their peers or teachers and reflecting on their learning. Ask me any questions that you need so that you can write a very well designed lesson.

Instructions	Output	Organize the information in a table with 4 columns. Column #1 - Duration Column #2 - Name of these four categories: Activate Learning, Promote Thinking and Discussion, Facilitate Demonstration of Learning and Monitor and Provide Feedback. Column #3 - Detailed description of activities and questions that can promote students' critical thinking according to the four categories stated in Column #2. Column #4 - Justify the reason why you chose those activities and questions.
	Qualities of output	The lesson plan should be simple yet detailed enough for any teacher to understand and carry out the lesson.
	Do's and don'ts	Don't start designing the lesson until I give you the context to my lesson

Context	Subject	The subject is	**Insert subject here**
	Topic	The topic is	**Insert topic here**
	Grade level	My students are in	**insert age and grade level**
	Class size	My class size is	**insert class size**
	Class ability	My students abilities are	**insert any notable learning differences, abilities or needs**
	Duration	Duration of my lesson is	**insert duration here**
	Key Concepts	The key concepts for this lesson are	**insert concept(s) here**
	Success Criteria	At the end of the lesson, students will be able to	**insert success criteria here**
	Pedagogy	Use the following pedagogy to design the lesson:	**insert specific pedagogy (e.g. Blended Learning, Concrete-Pictorial-Abstract (CPA), Flipped Learning, etc)**
	Key Application of Technology (KAT)	Integrate technology where necessary and meaningfully to	**support Assessment for Learning, foster Conceptual Change, provide Differentiation, facilitate Learning Together, develop Metacognition, enable Personalisation or Scaffold the learning**
	21CC	Integrate the acquisition of the following 21st century skills:	**insert 21CC skills**
	Evidence of Learning	I want to students to show me evidence of their learning using	**insert evidence of learning (e.g. online responses, group discussion and workbook/worksheets)**
	Prerequisite knowledge	My students already know	**insert any prerequisite knowledge here**
	Resources	Use the following resources in your lesson plan:	**insert resources (e.g. Chromebooks, iPads)**

Research Project Implementation

Phase #1—Design

Phase one will involve completing the development of the AI-ELD prompt framework, lesson plan assessment rubrics, and follow-up prompts in collaboration with members from the AIEd Planners interest group, Dr. Brian Sharp, and Dr. Holly Rougeaux.

Phase #2—Deployment

Phase two will involve guiding educators in learning how to use the AI-ELD process through a hybrid-flexible course model (Beatty, 2007), which consists of in-person workshops, synchronous online workshops, and asynchronous online learning modules. Educators may choose any mode of learning as described below.

1. In-person workshop(s)—Any face-to-face workshops (e.g., teachers' conferences and Excel Fest (TCEF) or Teacher-Led Workshops (TLW).

2. Synchronous online workshop(s) – Any online workshops or webinars (e.g., Singapore Learning Designers Circle (SgLDC) virtual meets, which are conducted quarterly).

3. Asynchronous Online Learning Module – An online module created and hosted on two separate platforms—Singapore Student Learning Space (SLS) and Google Forms:

    a. Singapore's SLS lesson uploaded into the community gallery will be accessible to any public-school educator in Singapore.

    b. Google Forms (link) contains video tutorials, links to the require resources and the ability for participants to submit their reflections. This will be used by educators who do not have access to SLS.

Phase #3—Future Development

The future development of my research project would involve collaborating with the ETD, a branch of Singapore's MOE. The goal is to explore the integration of the AI-ELD process into Singapore's national learning management system (LMS)—the SLS. My aspiration is for AI-ELD to become a seamless part of the lesson planning and design process for teachers. Furthermore, I hope to enable AI to adapt to Singapore's educational context, for instance, using a programmable AI chatbot. This adaptation would ensure that AI-generated lesson plans are more closely aligned with our national curriculum and the specific educational needs of our students.

Discussion

There was a great buzz among those with whom I shared this project, as they all believed that there is great potential for AI to assist them in their lesson designing process. One such individual was Dr. Valerie Long, Conference Chair of the Western Pennsylvania Mathematics Teaching and Learning Conference held at Indiana University of Pennsylvania on October 14, 2023. She inquired if I could present my project at one of the concurrent sessions of the conference. I was honored and delighted to share the framework during the session titled, "Supercharge Lesson Planning with AI!".

Dr. Stephan Schaffrath, course instructor of our Fulbright Seminar, has also asked me to facilitate a short sharing and hands-on practice of the AI-ELD framework with the other Fulbright FDAI participants during one of our weekly Fulbright Seminars. The reception to the framework at both sessions, as well as the feedback I received from the AIEd Planners: Navigating the Future of Lesson Design with AI interest group, was highly positive and

underpins the validity and value of my project. As mentioned, I hope to continue collaborating and developing this framework further with Singapore's Ministry of Education so that it can be made easily accessible to all educators in Singapore. I will also continue working with Dr. Brian Sharp to write and publish an academic or research paper on the AI-ELD Process, enabling educators from all over the world to benefit.

The educators with whom I collaborated all came to this consensus: AI cannot design a perfect lesson plan, primarily because it does not understand our students as deeply as we do. Effective lesson planning is not solely about knowledge; it is equally about the relationship teachers have with students. Teachers ought to view AI as a tool to initiate the planning process or to seek inspiration. It is akin to exchanging ideas with a colleague, except this colleague possesses access to an immense wealth of information.

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Appendix

1. Compiled links to all the necessary resources required by educators when using the AI-Enhanced Lesson Design (AI-ELD) Process. bit.ly/aield

2. *Supercharge Lesson Planning with AI* concurrent session at the Western Pennsylvania Mathematics Teaching and Learning Conference, held at Indiana University of Pennsylvania on October 14, 2023. The Padlet also contains the slides and recordings of the session. bit.ly/superchargewithai2023

3. Facilitation plan for the in-person workshops and synchronous online workshops - bit.ly/aield-facplan

4. Screenshots of the asynchronous online learning module on Singapore's Student Learning Space (SLS).
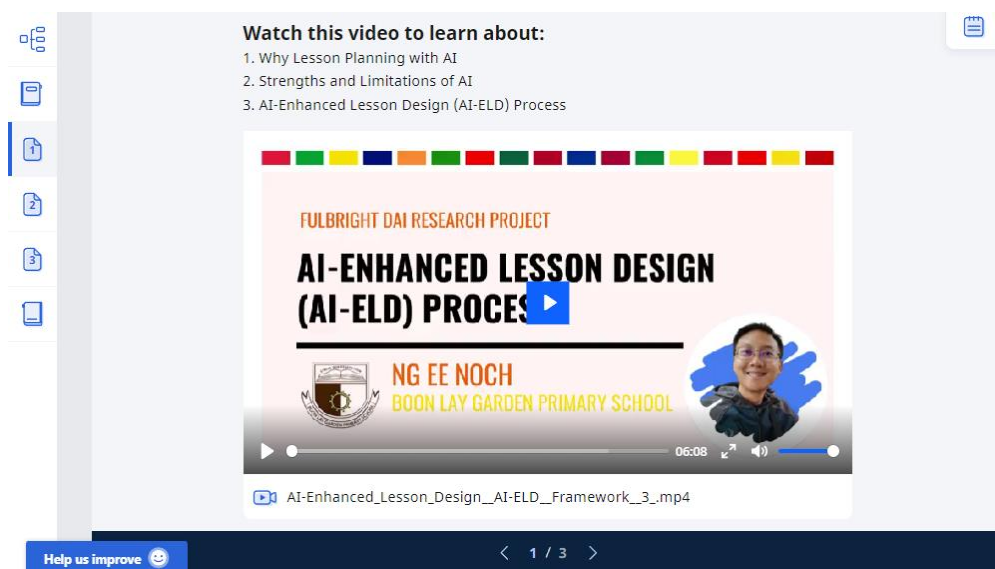
Video tutorial explaining the AI-ELD Process in detail

Using Interactive Thinking Tool (ITT) to facilitate reflection screenshot

Screenshot of the asynchronous online learning module on Google Forms

Which aspect of the process EXCITES you the most? *

Your answer

What was the MUDDIEST point of the process? *

Your answer

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Screenshot of participants' self-reflection questions which relate to the video describing the

AI-ELD process