**Socratic Method Evaluation Form**

In this paper, we apply the Mixed Socratic Prompting Approach to a range of problems in chemistry and materials science, developing a structured methodology to enhance LLM reasoning through Socratic inquiry. This framework is designed to evaluate the performance of the Socratic Prompting Approach by comparing it with regular LLM reasoning. It is structured to help you track and assess LLM performance across different approaches. Please complete the provided sections accordingly.

Name, Surname: Lateef Jolaoso

E-mail: ljolaoso@anl.gov

Field: Process design and optimization

Are you the expert on the field of question? Yes No

Does this prompt directly relate with your active research area? Yes No

1. Go to **ARGO** and select **Custom Task Type.**
2. **Write your prompt in a conventional, direct-answer manner.**

Prompt:

What is the best formulation for the anode of protonic ceramic electrochemical cells

Add follow up prompts below:

Follow-up 1:

How do we define the key performance metrics for an anode in protonic ceramic electrochemical cells, and what are the competing hypotheses about which materials best meet these metrics?

Follow-up 2:

What specific properties of perovskite oxides make them a strong candidate for anode materials, and how do these properties compare to those of alternative materials like mixed ionic-electronic conductors?

Follow-up 3:

Are there any assumptions about the limitations of perovskite oxides that could be challenged by recent advancements in material science?

Do you have more follow-up prompts? Yes No

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1. **Evaluate the performance of conventional approach.**

|  |  |
| --- | --- |
| Clarity | 5 |
| Depth of reasoning | 3 |
| Hypothesis refinement | 2 |
| Novelty of insights | 2 |
| Consistency | 3 |
| Applicability to real problems | 4 |
| Logical Coherence | 3 |
| Correctness of conclusions | 4 |
| Self-correction & iteration | 2 |
| Overall effectiveness | 4 |

1. **Enter observations and comments about conventional approach.**

It gives lengthy comprehensive answers and conlusions. It might not be a good tool for idea prompting

1. Start a new chat on ARGO, and switch to Socratic prompting. Develop a reasoning flow for your problem. Refer the page 17*,* ***Socratic Questioning & Chain-of-Thought Prompting*** section in the paper. Use **Figure 2 & Tables 3 & 4** to select Socratic principles.
2. Did you used same prompt at the beginning? Yes No
3. Did you use same follow up prompts? Yes No

If your answer is no, please fill the boxes below.

Follow-up 1:

Click or tap here to enter text.

Follow-up 2:

Click or tap here to enter text.

Follow-up 3:

Are there any assumptions about the limitations of perovskite oxides that could be challenged by recent advancements in material science?

Do you have more follow-up prompts? Yes No

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1. **Evaluate the performance of Socratic Prompting approach.**

|  |  |
| --- | --- |
| Clarity | 4 |
| Depth of reasoning | 3 |
| Hypothesis refinement | 4 |
| Novelty of insights | 4 |
| Consistency | 3 |
| Applicability to real problems | 3 |
| Logical Coherence | 4 |
| Correctness of conclusions | 3 |
| Self-correction & iteration | 3 |
| Overall effectiveness | 4 |

1. **Enter observations and comments about Socratic Prompting approach.**

1. **Analysis of results from an expert point of view.**

The question generation prompts are very useful an essential in understanding key factors and metrics to pay attention to before laboratory experiment. This can also help in saving man-hour to be wasted in the lab.

1. **Evaluate the performance of Socratic and non-Socratic responses. Which one provides accurate and reliable responses? Why?**

Their high level responses is somewhat similar. However, the non-Socratic give more comprehensive and specific responses. For the socratic responses, their question formulation and been concise is one of its advantage over the non-socratic which can help with critical thinking and idea probing. The non-Socrative provide better examples and the socratic is more general.

1. **What are the limitations and possible improvements?**

Defining comprehensiveness will help to be able to perform its unique function and also that of a non-socratic method