Can NotebookLM Support English Language Learners? A Theoretical Perspective on AI Tools in Education

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Abstract. The rapid rise of artificial intelligence (AI) in education has sparked interest in its potential to assist English Language Learners (ELLs). This paper explores the theoretical potential of Google's NotebookLM – a note-taking and research assistant launched in mid-2023 – as an AI tool to support ELLs. We consider how NotebookLM might aid in vocabulary acquisition, academic writing, reading comprehension, and self-regulated learning, despite a current lack of empirical studies on this specific tool. Drawing on existing literature about AI-powered language learning tools (e.g. Grammarly, ChatGPT, Duolingo) and principles of notetaking in learning, we discuss NotebookLM's alignment with key second-language acquisition (SLA) theories. Major frameworks such as Vygotsky's Zone of Proximal Development (ZPD), self-regulated learning theory, and cognitive load theory provide lenses for understanding how AI can scaffold learners and personalize learning. While optimistic about NotebookLM's promise to generate summaries, answer questions, and simplify content for learners, we emphasize the need for critical early discussion of its limitations. The paper concludes by calling for empirical research and pilot studies, advocating cautious optimism in embracing NotebookLM and similar AI tools in English language education.

Key words: *NotebookLM, English Language Learners (ELLs), AI in Education, Self-Regulated Learning*

1. Introduction

The emergence of advanced AI tools is reshaping education, offering new ways to personalize and support learning. In particular, generative AI and large language models have made headlines for their potential to assist both teachers and students. Tools like ChatGPT, introduced in late 2022, demonstrated how AI could provide instant feedback, language practice, and information on demand. Educators worldwide are now grappling with how best to integrate such technologies into classrooms in meaningful, responsible ways. In this context, AI is seen as a double-edged sword: it promises individualized support and innovative learning experiences, yet raises concerns around efficacy, ethics, and equity. The rising role of AI in education thus warrants close examination, especially in fields like language learning where interaction and feedback are crucial.

One recent innovation is **NotebookLM**, unveiled by Google in mid-2023. NotebookLM is described as a "virtual research assistant" that leverages AI (Google's Gemini model) to help users interact with

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their documents. In essence, it allows a learner to upload texts (such as articles, PDFs, or notes) and then ask the AI questions about that content or request summaries and explanations. The AI synthesizes information from the user's sources to generate helpful responses, complete with citations to the original documents. For example, a student could feed an English article into NotebookLM and ask, "What are the key points of this text?" or "Explain this paragraph in simpler words," and the tool would produce an AI-generated summary or clarification grounded in the provided material. This promises a form of on-demand, context-specific support for learning and research.

Figure 1:

Screenshot of the original NotebookLM interface, showing an uploaded document alongside an AI-generated sidebar with key topics, suggested questions, and a query box. Such features illustrate how NotebookLM can guide learners by highlighting important concepts and prompting inquiry.
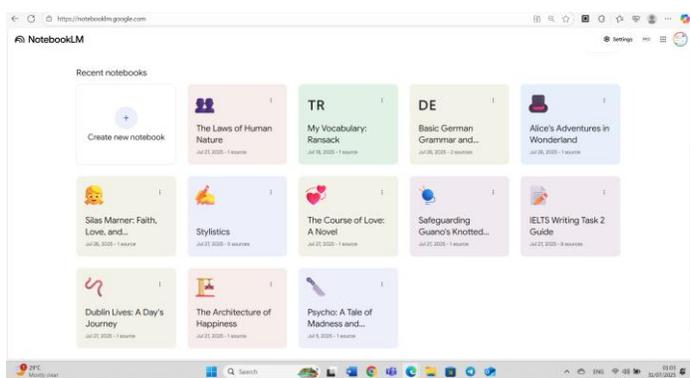
NotebookLM's launch is so recent that it remains largely untested in real classrooms. It evolved from an experimental project ("Project Tailwind") into a limited release in July 2023, and by late 2024 it shed its beta status and even introduced a subscription-based "NotebookLM Plus" for advanced features. As of 2025, the tool has been adopted by some researchers, students, and professionals as an aid for synthesizing notes and sources. However, there is a **notable gap in empirical research**: no published studies yet examine NotebookLM's impact on learning outcomes or its efficacy for any learner population. This absence is especially evident regarding **English Language Learners (ELLs)** – students who are learning English as a second or foreign language. Given how new NotebookLM is, educators and researchers have not had time to formally evaluate it with ELLs, despite its potential relevance.

English Language Learners (ELLs), in both global and academic contexts, form a significant portion of learners today. Globally, an estimated 1.5 to 2 billion people are learning English – roughly 20% of the world's population. This includes a wide spectrum: from children in bilingual elementary programs, to international university students studying in English, to adult learners in EFL (English as a Foreign Language) contexts around the world. In U.S. K-12 education, "ELL" typically refers to students in public schools who are not yet proficient in English and require specialized support in mainstream classes. These learners face distinct challenges. For instance, when reading academic texts, ELLs often encounter *unfamiliar vocabulary and complex grammar structures* that native speakers find routine. Limited vocabulary knowledge and difficulties with idioms or academic language can impede

their reading comprehension. Grammatical errors and lack of fluency can hinder their writing. Many ELLs also struggle with listening (due to new accents or fast speech) and speaking (due to lack of confidence or fear of mistakes). In essence, ELLs need support in **vocabulary acquisition, grammar development, reading comprehension, writing fluency, and oral communication**. They benefit from scaffolding – i.e. instructional support that makes challenging content accessible – and from personalized practice that targets their specific gaps.

Considering both the novelty of NotebookLM and the needs of ELLs, the **research question** guiding this paper is: **Can NotebookLM meaningfully support English language learners in the near future, and if so, in what ways?** We approach this question as a *theoretical exploration*, mapping out potential roles and limitations of NotebookLM for ELLs based on what is known from related literature. Our aim is not to provide empirical evidence (which is currently lacking) but to discuss how NotebookLM *could* be utilized or why it *might* be beneficial, grounded in established theories of language learning and educational technology.

In pursuing this aim, we will first review relevant literature on AI in language education (Section 2) to situate NotebookLM among other tools that have been studied (such as intelligent tutoring systems, Grammarly, Duolingo, chatbots, etc.). We will then outline key theoretical frameworks (Section 3) – notably **Vygotsky's Zone of Proximal Development (ZPD)**, **self-regulated learning**, and **cognitive load theory**, as well as principles from **Computer-Assisted Language Learning (CALL)** – to provide lenses through which NotebookLM's functionality aligns with known learning mechanisms. Next, we propose several potential use cases for NotebookLM in English language teaching (ELT) and learning (Section 4), ranging from academic writing support to vocabulary building and autonomous study, including hypothetical classroom scenarios. In the Discussion (Section 5), we critically examine the promise of these ideas versus the unknowns and risks (such as over-reliance on AI, ethical concerns like data privacy and bias, and the danger of hype outpacing evidence). Finally, the Conclusion (Section 6) summarizes key points and emphasizes the need for empirical research and careful optimism when integrating NotebookLM or similar AI tools in education. In short, this paper serves as an early conceptual inquiry into how a cutting-edge AI notebook might transform or trouble the landscape of English language learning.

2. Literature Review

To understand NotebookLM's potential, it is important to review prior research on AI-powered tools in language education, the role of notetaking and summarization in learning, and the specific needs of ELLs that such tools might address. This section synthesizes findings from studies on existing language-learning technologies and highlights gaps that NotebookLM could fill.

2.1 AI in Language Education: Emerging Tools and Findings

Artificial intelligence has been making inroads into language education for several decades, but recent advances in natural language processing have accelerated the development of sophisticated tools for learners. A variety of AI-powered applications have been used or studied in the context of language learning:

- **Grammar and Writing Assistants:** Tools like **Grammarly** use AI algorithms to provide instant grammar correction, writing enhancement suggestions, and sometimes even stylistic feedback. Research generally shows positive impacts of such tools on ELL writing. For example, a systematic review by Dizon & Gayed (2024) found that Grammarly's automated writing evaluation system effectively reduces grammatical errors in L2 writing and supports the revision process. Individual studies have reported that Grammarly not only helps students catch errors but also *increases their writing confidence and autonomy* in learning, as students can self-edit with AI support. However, reviews note limitations too – e.g. Grammarly's feedback, while useful, lacks the *teaching presence* a human teacher provides for deeper explanations. These tools work best as supplements to instruction rather than replacements, and students may need guidance to understand AI feedback (which can sometimes be incorrect or context-insensitive). Nonetheless, Grammarly exemplifies how AI can assist one of ELLs' toughest challenges – producing grammatically accurate, clear writing – by acting as a real-time proofreader and coach.

- **Intelligent Tutoring and Practice Apps:** Another class of AI language tools are intelligent tutoring systems and apps for practice, such as **Duolingo** (a popular gamified language learning app) and various chatbot-based tutors. **Duolingo**, while not a conversational AI per se, uses machine learning to adapt exercises to the user's level and has an AI-driven feedback loop. Studies have shown Duolingo can be beneficial for vocabulary acquisition and basic grammar practice. For instance, prior research indicates that using Duolingo leads to higher achievement in vocabulary and grammar for EFL students, compared to traditional homework, and can improve learner engagement. A recent experimental study by Ouyang, Jiang, & Liu (2024) found that Duolingo usage had a *significant positive effect on EFL learners' engagement and willingness to communicate*, boosting their confidence in speaking and overall language attitudes. Learners appreciated the app's adaptability and the game-like environment, which kept them motivated. That said, the literature also points out challenges: Duolingo and similar apps often focus on individual use, lacking rich interpersonal interaction, and require reliable internet and devices – resources not all learners have. They also cannot fully replace the nuanced feedback of a teacher. Still, such AI-integrated apps illustrate how technology can provide ELLs with extra practice outside the classroom and reinforce fundamentals in an engaging way.

- **Conversational AI and Chatbots:** With recent leaps in natural language generation, **chatbots** and conversational agents have become a hot topic in language education. Chatbots range from rule-based dialogue systems to advanced generative models like ChatGPT. They offer the enticing possibility of a 24/7 conversation partner for language practice. Research in this area is rapidly growing. A meta-analysis of studies on AI chatbots in L2 learning found an overall positive effect on language learning performance (approximately $g = 0.48$), indicating that students who practiced with chatbots outperformed those who didn't on average. Chatbot interactions have been shown to improve learners' *speaking confidence, engagement, and vocabulary acquisition* in particular. For instance, Lin et al. (2023) reported that employing a GPT-based

chatbot significantly aided students in learning new vocabulary words in context. Other studies note that chatbots can lower learners' anxiety by providing a judgment-free environment to make mistakes and repeat exercises. Even *non-educational* chatbots like **Replika** (an AI "companion" app) have been informally used by learners to practice casual conversation in English, with some reporting improved fluency through regular chatting. However, challenges include the *accuracy and appropriateness* of chatbot responses (early versions sometimes gave incorrect or nonsensical replies), as well as the difficulty of ensuring sustained, pedagogically rich interactions. Some chatbots lack pedagogical design – they converse but do not necessarily *teach* or correct the user. Newer large language model (LLM) based systems like ChatGPT can generate fluent answers and even explain grammar or provide feedback, but they may also produce *misinformation or overly advanced language* that could confuse learners. Despite these caveats, the trend is clear: **AI conversational agents are becoming valuable tools for language practice**, capable of increasing access to interaction in the target language where human partners are not readily available.

- **Other AI Tools:** Beyond these, there are AI-driven translators (e.g. Google Translate) which ELLs commonly use to bridge understanding of new words or even to draft texts (though over-reliance on translation can impede actual language development). Speech recognition technology (like in pronunciation apps or dictation tools) uses AI to give learners feedback on their pronunciation or to enable them to practice speaking by responding to prompts. Automated essay scoring systems and AI writing evaluators (such as ETS's e-rater or Turnitin's Draft Coach) are also used in some academic settings to help students iterate on writing. Each of these has its own body of research; broadly, they show that **immediate feedback and individualized guidance** afforded by AI can help address learners' specific weaknesses, provided the feedback is accurate and the learners are trained to use it constructively.

In summary, existing AI tools have demonstrated benefits for language learners: *automated feedback can reduce errors*, *adaptive platforms can boost engagement*, and *chatbots can increase practice opportunities*. Table 1 summarizes a few key findings from recent studies on AI in language learning:

- *Grammarly (writing AWE):* Reduces grammar errors and improves revision quality; can lower writing anxiety and encourage autonomous correction.

- *Duolingo (adaptive app):* Increases vocabulary and grammar gains in beginners; enhances engagement and confidence in using language.

- *Chatbots/ChatGPT:* Moderate positive effect on overall performance (g ~0.48); improves spoken fluency and vocabulary, though must guard against misinformation.

- *AI speech tutors:* (e.g., apps using speech recognition) – help improve pronunciation and listening discrimination, although accent and recognition errors can occur.

Notably, **NotebookLM** did not exist when most of this prior research was conducted, so it is not mentioned in these studies. However, NotebookLM shares DNA with some of the above tools. Like Grammarly, it deals with written text and could offer corrective feedback or suggestions (though its

focus is summarization, not error correction). Like chatbots, it allows a form of Q&A interaction – the user asks a question in natural language and the AI responds – albeit the conversation is anchored to uploaded documents rather than free-ranging. Like intelligent tutors, NotebookLM could adapt to a learner's input (the content they provide) and generate personalized output (notes, summaries). Therefore, one can hypothesize that **the advantages observed with other AI tools might also apply to NotebookLM** if used in analogous ways. For instance, if Grammarly's feedback fosters self-editing skills, perhaps NotebookLM's explanatory answers could foster self-study skills; if Duolingo's adaptive practice keeps learners motivated, perhaps NotebookLM's ability to answer any question about a text keeps learners curious and engaged in reading. These conjectures need validation, but they provide a starting point for envisioning NotebookLM's educational value.

2.2 Notetaking, Summarization, and Learning

NotebookLM is fundamentally a note-centric tool – it creates notes (summaries, Q&As) from source materials. Thus, it embodies principles of **notetaking, summarization, and personalization** that have long been known to aid learning. We review some of these principles here.

Cognitive and Metacognitive Value of Summarization: Summarizing a text is a powerful learning strategy. Research in reading comprehension shows that when students summarize, they are actively identifying main ideas and distilling information, which leads to deeper processing. Summarizing is considered a key *metacognitive strategy* that significantly enhances reading comprehension. By having to restate content in their own words, learners engage in *metacognitive monitoring* — they must check if they truly understand the material. As one study noted, *summarization training improved students' attention to text and their metacognitive control of the reading process*, particularly for ELLs who need to consciously employ strategies to understand complex English texts. In essence, creating a summary forces learners to extract the gist and organize their thoughts, which strengthens memory retention and comprehension accuracy.

NotebookLM's core functionality – generating summaries or "notes" from a document – aligns with this learning strategy. In a theoretical sense, if an ELL reads a difficult article and then uses NotebookLM to produce a summary, the AI is modeling the act of summarization. The student can compare the AI summary with their own understanding, potentially revealing gaps ("Oh, I missed that key point in my reading"). Additionally, the AI summary itself can serve as a simplified version of the text, which the student can study to reinforce comprehension. One could liken this to having a tutor who highlights the *important points* after you read. Of course, a concern is that if the AI does all the summarizing, the student might skip doing it themselves. We will address such limitations later. Still, from a cognitive load perspective, an AI-generated summary *reduces the volume of text* a learner has to grapple with at once, focusing their attention on the essential points – this potentially lowers **extraneous cognitive load** and allows more working memory to be devoted to understanding core concepts.

Annotation and Active Notetaking: Educational research also emphasizes the benefits of active notetaking and annotation. Rather than reading passively, when learners *annotate* a text (underline, write margin notes, highlight key ideas), they process the material more deeply. Annotation is an active

reading strategy that improves comprehension and retention. It requires students to *put information into their own words*, which means they must understand it first. In traditional settings, teachers encourage ELLs to keep vocabulary notebooks, jot down main ideas of paragraphs, or write summaries of chapters as forms of note-taking. These practices are linked to better recall and learning outcomes. For example, a student who writes a brief summary at the end of each textbook section is more likely to remember the content than one who simply reads through, because the act of note-making consolidates knowledge.

NotebookLM's design effectively provides a digital space for this kind of *personal note creation*. The user can upload multiple documents into a "notebook" and ask the AI to generate notes, which they can edit or add to. It can also suggest questions one might ask about the content. This is akin to prompting the student with cues – a metacognitive support. By compiling a **personalized AI-generated study guide**, ELLs could benefit from organized, concise notes tailored to the materials they need to learn. Moreover, NotebookLM allows saving AI responses as notes within the app, meaning a learner can iteratively build up a knowledge base. For instance, imagine an ELL graduate student reading several journal articles: they could use NotebookLM to summarize each article, then have a set of summaries (in simpler language) to review for understanding or for writing their literature review. While traditional annotation is manual, here the AI accelerates it – but the *personalization* remains, since the notes are based on the user's chosen sources and questions. In educational theory, personalized content is known to boost engagement and relevancy for learners. AI systems can adapt to individual student needs, improving outcomes through customized content and feedback. Thus, NotebookLM's ability to tailor outputs to a learner's specific documents exemplifies personalized learning: the *student is effectively telling the AI what they are interested in or need to learn*, and the AI responds with targeted information.

It's worth noting that **self-regulated learning** strategies often include summarizing and note-reviewing as key tactics. Successful learners plan how to approach a text, monitor their understanding (e.g., by writing margin notes or summaries), and evaluate what they learned (perhaps by quizzing themselves on their notes). NotebookLM could function as a tool to facilitate these strategies – a point we discuss more in the theoretical framework section. For now, the literature establishes that summarization and annotation are beneficial; therefore, a tool that produces summaries and encourages questions can be seen as *aligned with evidence-based study practices*. Early user feedback on NotebookLM (as reported by its developers) noted that people were using it to "make sense of…piles of papers" and "generate study guides" for themselves, indicating that even without formal studies, the intuitive applications are in line with known good practices (organizing and synthesizing information for learning).

2.3 ELL Needs and AI Tool Alignment

As highlighted, ELLs have particular needs in language learning. We now connect those needs with capabilities that AI tools – and by extension, NotebookLM – might offer, based on literature:

- **Vocabulary Acquisition:** ELLs must acquire thousands of new words to be proficient, including general vocabulary and academic terms. This requires repeated exposure, clear

definitions, and contextual examples. AI can support vocabulary learning by providing *on-demand definitions and examples*. For example, if a student doesn't know a word in a reading, a tool like NotebookLM could be asked "What does *ambivalent* mean in this context?" and the AI might generate an explanation or simpler synonym, potentially even in the student's first language if translation is enabled. Prior AI tools like dictionary apps and translator bots have been widely used for this purpose, but NotebookLM could go further by **explaining usage in context** (because it has the whole document context). This resembles an AI tutor highlighting vocabulary. Research by Yunus et al. (2022) on mobile learning for ELLs found that easily accessible definitions and examples in apps improved students' vocabulary retention, as they could quickly resolve unknown words without losing reading flow. NotebookLM could fulfill a similar role by acting as a smart glossary for any text.

- **Grammar and Writing Corrections:** ELLs often need corrective feedback on grammatical errors and writing structure. While NotebookLM is not primarily a grammar checker, it can still assist writing. A learner could paste their essay draft into NotebookLM and ask questions like "Can you suggest improvements to this paragraph?" or "Is there a better way to phrase this sentence?" The AI might then paraphrase or point out unclear parts. This is analogous to how students use ChatGPT to get writing advice. Studies have observed mixed but promising results in using AI for writing feedback – for instance, some EFL students using an AI chatbot to review their drafts reported improved organization and idea development. The chatbot wasn't perfect in grammar correction, but it provided *alternative phrasings* that students learned from. Similarly, NotebookLM could help with *academic writing* by organizing references (upload sources, get summaries and quotes to use, which aids proper citation) and by clarifying complex source material so the student can integrate it better into their writing. While empirical evidence is not yet available, one could theorize that NotebookLM might reduce cognitive load for ELL writers by synthesizing reference information (so they don't have to mentally juggle many English texts at once). This aligns with cognitive load theory's recommendation to *segment and simplify information* to avoid overwhelming learners.

- **Reading Comprehension:** ELLs often struggle with reading comprehension, especially of long or complex texts above their proficiency level. Key hurdles include unknown vocabulary (addressed above), complex syntax, and culturally embedded references that they might not know. Summarization and explanation can dramatically help here. In bilingual education, teachers often provide **scaffolds** like summaries or guiding questions to help students grasp content in a second language. NotebookLM could automatically generate such scaffolds. For instance, an ELL in a history class could upload a dense chapter and ask "Summarize this in simple English" – effectively getting a more digestible version. They could also ask specific questions: "Why did the author mention the Treaty of Versailles here?" to get context. This is similar to having a personal reading tutor. The theoretical benefit is grounded in Vygotskyan scaffolding: the AI provides **support within the learner's zone of proximal development** for reading – explaining what the learner can't understand alone, thus enabling them to finally comprehend the text with assistance. Prior research on summary tools (not necessarily AI –

even human-provided summaries) shows they improve ELLs' comprehension and content learning because students can confirm if they understood correctly. Additionally, asking and answering questions about a text is known to improve recall and understanding (the self-questioning strategy). If NotebookLM suggests or answers questions about the text, it engages learners in that active processing. This aligns with generative learning strategies that promote better retention.

- **Speaking and Listening Practice:** Although NotebookLM is not a spoken dialog agent (it's primarily text-based, though it has an *Audio Overview* feature that creates a podcast-like summary), it could indirectly aid speaking/listening. For example, an ELL could use NotebookLM to generate a concise outline of a presentation they need to give, then practice speaking from that outline. Or they might ask NotebookLM to generate sample questions that listeners might ask after their presentation, allowing them to prepare responses. In terms of listening, the *Audio Overview* feature (where the AI produces an audible conversation summarizing a document) might help listening comprehension, especially because it was expanded to support 80+ languages. In theory, an ELL could listen to an audio summary in English to practice understanding, or potentially in their native language if they just need content knowledge. However, as a monolingual (English) learning tool in text mode, NotebookLM's speaking/listening support is limited unless one uses external text-to-speech for its outputs. This is a noted limitation: many AI tools (like GPT chat) currently function strongest in text, which may not directly improve oral skills unless creatively implemented by a teacher (e.g., having students discuss the AI's answers).

- **Learner Autonomy and Confidence:** A recurring theme in supporting ELLs is fostering *learner autonomy* – empowering them to take charge of their learning outside the classroom. AI tools, by virtue of being available on-demand, can encourage autonomous learning behaviors. Duolingo, for instance, works largely because learners can use it anytime, setting their own pace and goals. Research indicates that students who supplement their classroom learning with autonomous use of apps or online resources often progress faster, as they engage in more practice and self-reflection. NotebookLM could similarly encourage autonomy: an ELL can use it to clarify doubts without immediately running to a teacher, thus practicing problem-solving. If a student is too shy to ask a "dumb question" in class, they might freely ask NotebookLM and get an explanation, which might then bolster their confidence to participate in class with the understanding they gained. Of course, the student needs to have enough English skill to interact with the AI meaningfully (posing questions clearly). But even that act – formulating questions in English – is good practice. One could imagine learners feeling more in control: instead of waiting passively for a teacher's explanation, they actively query the AI. This is aligned with self-regulated learning models where *help-seeking* is a positive strategy. Zimmerman (2002) notes that self-regulated learners strategically seek assistance when needed while maintaining responsibility for their learning. NotebookLM offers a new avenue for help-seeking – a sort of "virtual coach" or reference at one's fingertips. Early anecdotes from users inside Google reported that employees were using NotebookLM to **"manage their own**

notes and ideas" and parse information faster, which suggests a boost in independent productivity. Translating that to ELL education, one can foresee motivated students using NotebookLM as a study companion to get through challenging English content on their own.

2.4 Gaps and Alignment with Theory

While the literature on AI in language learning is rich and growing, **NotebookLM itself has not been studied** at the time of writing. This is a critical gap that this paper's theoretical discussion begins to address. However, from the above review, we see that *NotebookLM's intended functionalities align with several key approaches in language education:*

- It emphasizes **summaries and guided notes**, which correspond to proven comprehension strategies (metacognitive summarizing, reducing cognitive load).

- It provides **just-in-time information and explanations**, echoing the scaffolding concept in sociocultural theory and the immediate feedback valued in CALL.

- It facilitates **personalized content interaction**, fitting within personalized learning paradigms and self-regulated learning principles (learners can focus on their chosen content, at their own pace, with AI support).

- It could enhance **engagement** by allowing interactive Q&A with texts, which resonates with communicative approaches that value interaction (even if here the interaction is learner-to-AI-to-text rather than learner-to-learner).

In short, NotebookLM is an amalgam of capabilities that we have seen in separate tools: summarizer, Q&A chatbot, research organizer. The literature reviewed gives reason to be optimistic that such capabilities can support language learning. Nevertheless, we caution that **no empirical evidence yet confirms these benefits for NotebookLM specifically**. There may be unforeseen challenges once it's implemented with real ELLs – for example, perhaps ELLs might over-trust AI summaries and not read deeply, or the tool's answers might not always be at the right difficulty level for learners. These are speculations that need testing.

Before turning to theoretical frameworks, we underscore the *need for early discussion* (as we are doing) precisely because teachers and students might start using these AI tools *before* research catches up. History has shown that technology often outpaces pedagogy; by the time formal studies are published, students may have already adopted the tech in unstructured ways. Thus, mapping NotebookLM's potential roles now, through the lens of established theory and analogous research, can guide educators who are considering piloting it. It can also help researchers identify what questions to ask first (e.g., "Does NotebookLM's summarization improve ELL comprehension as theory predicts, or do any negative effects emerge?"). In the next section, we ground this discussion in theoretical frameworks to further articulate why and how NotebookLM might support ELLs' learning process.

3. Theoretical Framework

In this section, we examine NotebookLM's potential through one primary and two supplementary theoretical lenses: **Vygotsky's Zone of Proximal Development (ZPD)** as the main framework, complemented by **self-regulated learning theory** and **cognitive load theory**. These frameworks help explain the pedagogical rationale for using AI tools like NotebookLM and anticipate their impact on learning. We also relate the discussion to perspectives from **Computer-Assisted Language Learning (CALL)** where relevant.

3.1 Vygotsky's Zone of Proximal Development (ZPD) and Scaffolding

One of the most influential concepts in education and second language acquisition is Lev Vygotsky's Zone of Proximal Development. The ZPD is defined as *"the distance between the actual developmental level (what a learner can do independently) and the level of potential development (what they can do with guidance or collaboration)"*. In simpler terms, it is the range of tasks a learner **cannot yet do alone but can accomplish with support from a more knowledgeable other**. Learning is maximized when instruction targets this zone – challenges just beyond the learner's current ability, accompanied by appropriate assistance (often termed *scaffolding*).

Traditionally, the "more knowledgeable other" providing scaffolding is a teacher or a peer. However, in modern educational technology, we can conceive of AI as an additional *mediator* or assistant in the learning process. **NotebookLM can be viewed as a form of scaffold for ELLs.** It has the capacity to supply immediate support in areas where an ELL might struggle if left unaided. For example, consider an intermediate ELL faced with a science textbook chapter full of complex sentences and new terms. Reading it alone, the student might only grasp 50% of the content (their independent level). With a teacher, the student could potentially reach near 100% comprehension as the teacher explains difficult parts – this teacher support represents functioning in the ZPD. If NotebookLM can provide some of those explanations and simplifications, it can play a *scaffolding role within the student's ZPD*.

Key features of effective scaffolding include: **contingency** (support is tailored to the learner's immediate needs), **fading** (support is gradually removed as the learner becomes competent), and **transfer of responsibility** to the learner. How might NotebookLM embody these? The *contingency* is evident when a student asks a specific question – the AI's help is on-demand for that precise confusion. For instance, a learner asks, "What does this paragraph mean?" The AI responds with a simpler rephrasing. This is contingent support: it addresses the learner's identified gap at that moment. Over time, as the learner's proficiency grows (and possibly as they become more skilled at reading strategies), they might rely less on the AI – that would be the *fading* aspect. They might move from asking the AI for full summaries to just using it to check occasional doubts, and eventually perhaps only for verifying their own summaries. The *transfer of responsibility* occurs if the tool is used in a way that the learner gradually internalizes the assistance. For example, by regularly seeing how NotebookLM summarizes texts, the student may learn to emulate that process, thus improving their own summarization skill without always needing the AI.

Vygotsky's theory emphasizes that learning is a socially mediated process – originally referring to human mediation. But some CALL researchers (e.g., Warschauer, 1997) have argued that computers can mediate language learning by providing interaction and feedback. NotebookLM, while not a human, leverages a vast knowledge base and language model to *simulate some characteristics of an expert guide*. It can "encourage" the learner to delve deeper through suggested questions (this is akin to an expert prompting a learner to reflect). It *collaborates* in the sense that the learner and AI together explore the content – the learner drives the inquiry, the AI contributes information.

One could conceptualize NotebookLM as a form of **distributed scaffolding**: part of the scaffolding is embedded in the tool's design (e.g., it automatically highlights key topics from a document, which helps focus the learner's attention), and part is in the dynamic interaction (the Q&A between learner and AI). Notably, an advantage of AI scaffolding is its *availability and patience*. A student might be unwilling to ask a human tutor to explain something *three times*, but they could ask the AI repeatedly in different ways until they understand, without embarrassment. This encourages the learner to stay in their ZPD longer rather than giving up, because the support is non-judgmental and always accessible.

However, theoretical caution: For scaffolding to be effective, the support must be accurate and well-targeted. If NotebookLM gives a flawed explanation or too advanced an explanation, it might fall outside the learner's ZPD (either still too hard, or sometimes even misleading). This connects to the concept of **calibrated scaffolding** – the AI needs to adjust to the learner's level. Currently, NotebookLM doesn't "know" the learner's proficiency; it only knows the content. In theory, a learner could prompt it: "Explain this in simple English" to force a more calibrated response. This is something educators would need to guide students to do (i.e., teach them to ask for adjustments from the AI, which is a new literacy). The ideal scenario is that NotebookLM becomes *sensitive* to the complexity of its output relative to input – something future developments might improve (like an adjustable "reading level" setting on summaries).

In sum, ZPD theory provides a strong argument that **NotebookLM can scaffold ELLs by operating as a semi-intelligent partner**, helping them accomplish understanding and tasks just beyond their current ability. It embodies the idea that *what a learner can do today with support, they can do tomorrow independently*. If an ELL repeatedly uses NotebookLM to decode texts, eventually they may internalize some of those decoding strategies and rely less on external help. The notion of the AI as an MKO (more knowledgeable other) is perhaps an overstatement – the AI lacks true understanding or pedagogical intent – but from the learner's perspective, it is a source of knowledge and feedback, which functionally can fulfill part of the MKO role. This blends into the next framework: how the learner regulates their own learning with such a tool.

3.2 Self-Regulated Learning (SRL)

Self-regulated learning theory (Zimmerman, 2002; Pintrich, 2000) centers on how learners proactively control their learning process through goal-setting, strategy use, self-monitoring, and self-reflection. A self-regulated learner plans their approach (forethought phase), implements and monitors strategies (performance phase), and reflects on outcomes to adjust future efforts (self-reflection

phase). SRL is particularly relevant for ELLs in content courses or independent study, as they need to take initiative to practice language skills and address weaknesses outside of limited class hours.

Tools like NotebookLM could play a significant role in **enhancing self-regulated learning behaviors** because they provide resources that support each phase of the SRL cycle:

- **Forethought (Planning):** ELLs often have to plan how to tackle a difficult reading or how to study for an exam in a second language. NotebookLM can aid planning by generating outlines or study guides. For example, a learner might upload all their lecture notes into NotebookLM and ask "What are the main themes I should focus on for the test?" The AI might summarize key topics, helping the student create a study plan. By organizing information, the tool assists in *goal setting* ("I need to learn these 3 main themes") and *strategic planning* ("I will review each summary, then read details in the text"). In SRL terms, the learner is using an environmental structuring strategy – shaping their study materials with AI help – which is indicative of high self-regulation. Zimmerman (2002) highlights that self-regulated learners often set specific goals and plan the use of tactics; here NotebookLM can be one of those tactics (e.g., plan to use AI summaries to guide studying).

- **Performance (Monitoring & Strategy Use):** During the actual learning activity, students need to monitor their comprehension and employ strategies to overcome difficulties. NotebookLM shines in this phase by acting as a *monitoring tool*. If an ELL is reading and doesn't understand something, asking NotebookLM a question is a form of checking and seeking feedback, which is a metacognitive strategy. It's akin to *self-questioning*, a well-known comprehension monitoring tactic. Additionally, the ability to ask the AI to verify one's own summary ("Did I capture the main points correctly?") and see if the AI's summary differs can prompt the learner to notice gaps. This encourages reflection-in-action. Furthermore, NotebookLM can function as a **strategy enabler**: learners have strategies like summarizing, elaborating, or seeking examples; the AI can execute or assist those strategies. If a learner knows that "elaborating" helps (making connections or examples), they could prompt the AI: "Give me an example of this concept" – and the AI will do so, effectively helping the learner apply that strategy. In effect, the AI lowers the barrier to using complex strategies by doing some heavy lifting, which is important for ELLs who might struggle to, say, generate an example in English on their own. By making strategy use more accessible, the tool keeps the learner actively engaged rather than passively stuck.

- **Self-Reflection:** After completing a task (like reading a chapter or writing an essay), a self-regulated learner reflects on what went well, what they learned, and what needs improvement. NotebookLM can support this by, for instance, quizzing the learner or highlighting parts they didn't query which might indicate uncertainty. A possible use: after studying, an ELL could ask NotebookLM to generate a few quiz questions about the material (or use the AI's suggested questions) to test themselves. This is similar to using flashcards or practice tests – a very effective SRL technique. The AI might produce a question the student cannot answer, revealing a weakness, which the student can then address by reviewing that part of the notes.

This kind of **self-evaluation** is crucial to closing the loop in SRL. Moreover, because NotebookLM keeps a record of the questions asked and notes made, learners can reflect on their learning trajectory: "I see I asked a lot about vocabulary in the first half of the article but not later; maybe I improved or maybe I missed some?" – these data can feed into metacognitive awareness.

In summary, NotebookLM can act as a **cognitive partner** that augments a learner's self-regulation. It provides immediate feedback and information, which helps learners manage their learning without always requiring a teacher's intervention. Carneiro & Simoao (2011) discuss technology-enhanced environments for SRL, noting that digital tools can prompt learners to plan and reflect by structuring learning tasks for them. NotebookLM does exactly this structuring when it turns a chaotic set of documents into a structured Q&A or summary. It is plausible that using such a tool would encourage learners to take more initiative – knowing they have support might embolden them to tackle harder texts (raising their self-efficacy, a key motivational aspect of SRL). Of course, a potential pitfall is if learners become *too* reliant, as that could impede developing their own self-regulation skills. Ideally, however, the AI serves as a scaffold that is internalized.

One interesting angle is **motivation**: SRL is not just cognitive but also motivational. If an AI tool makes learning experiences more successful (e.g., an ELL understands a tough article with AI help rather than feeling lost), their motivation and self-efficacy can increase, leading to greater persistence. The tool can also gamify or make the process more interactive (even the simple interactivity of asking questions and getting answers can be more engaging than solitary reading). This motivational support is often under-emphasized but is critical especially for ELLs who might feel anxiety or frustration. Knowing "I have a helper I can rely on" might reduce anxiety and encourage practice, akin to how having a patient tutor would.

In conclusion, through the SRL lens, NotebookLM can be seen as fostering independent, reflective learning by providing *resources and feedback at each stage of the learning cycle*. It aligns with the idea of learners controlling their learning environment – here the learner literally controls an AI to adapt the learning material to their needs. Zimmerman's model stresses that self-regulation leads to higher achievement; thus, if NotebookLM indeed promotes SRL behaviors (like self-questioning, self-checking, goal-setting), one would expect improved language learning outcomes as a result.

3.3 Cognitive Load Theory

Cognitive Load Theory (CLT) provides another useful perspective, focusing on the cognitive processing demands placed on learners. CLT posits that working memory has limited capacity, and effective instruction should reduce unnecessary (extraneous) cognitive load so that learners can devote their mental resources to the germane processing of the material (i.e., truly learning it). Extraneous load comes from poorly designed materials or tasks that make a learner juggle too much irrelevant or disorganized information.

Applying CLT to the experience of an ELL, consider how cognitively overwhelming reading in a second language can be: the learner must decode vocabulary, parse unfamiliar syntactic structures,

possibly translate mentally, and connect ideas across sentences, all while trying to remember what they read earlier. The *intrinsic load* (inherent difficulty of the content) might be high if the topic is complex, and the *extraneous load* might be high if, say, the text is not well structured or if the learner lacks context. NotebookLM can mitigate extraneous load in several ways:

- **Information Organization:** By generating structured summaries or lists of key points, NotebookLM presents information in a more organized manner than a raw text might. For example, if a textbook chapter rambles through examples, the AI summary might extract the main principle and list a couple of examples clearly. This spares the learner from having to mentally organize the content themselves under capacity strain. As CLT advises, *providing worked examples and well-organized information* can ease cognitive load for novices. In this case, an AI summary is like a worked example of understanding the text – it shows how one might condense the text.

- **Reduction of Split-Attention:** Often ELLs have to refer back and forth between a text and a dictionary or grammar reference, which is a "split attention" situation that increases extraneous load. With NotebookLM, a learner can integrate these actions: instead of separately looking up words or Googling background info, they can ask the AI within the same interface. This integration means the learner's attention is less fragmented across multiple tools or pages – everything is in one "learning workspace." For instance, a student reading a PDF in NotebookLM's interface can click or query within that space itself, reducing the working memory cost of context switching.

- **Simplification of Language:** By rephrasing complex text into simpler English on request, the AI effectively lowers the *intrinsic load* to a level better suited for the learner's current proficiency. While one must be careful because oversimplification can remove important nuances (risking that germane processing of nuance is lost), in many learning scenarios with ELLs, simplifying language is necessary to ensure basic understanding before they tackle nuance. This is why teachers use techniques like *graded readers* (simplified books) for language learners. NotebookLM can act as an on-the-fly text simplifier, which in CLT terms means adjusting the task difficulty to match the learner's schema development. If the content is too far beyond the learner, they experience overload and learn little; with simplification, the content comes into a processable range.

- **External Memory Support:** Another aspect of cognitive load is that learners use *external tools to offload memory*. Taking notes or highlighting is one such tool – it allows the learner not to hold everything in their head. NotebookLM's notebooks serve this function by storing the AI-generated notes and answers. Later, the learner doesn't have to recall "What was the main idea of that article?" entirely from memory – they can look at the AI summary. This is akin to the concept of the "extended mind" or distributed cognition, where technology extends working memory. By relying on the notebook as an external memory aid, the learner's working memory can focus on understanding or analyzing rather than remembering raw information.

By applying CLT, we predict that ELLs using NotebookLM might experience *less cognitive overload* when dealing with difficult English materials. For example, a dense academic article might normally overwhelm an intermediate ELL (too many new words, complex ideas in each sentence). If NotebookLM breaks it down into a summary or question-answer format, the learner can process it piecewise, thus respecting the limits of working memory. Empirical support for this approach can be found in studies on segmentation and summarization: Mayer's multimedia principles, for instance, find that students learn better when information is segmented and pre-processed into digestible chunks rather than a continuous stream. NotebookLM essentially segments textual information via summaries and Q&A.

However, a potential trade-off: **germane cognitive load** is the effort that contributes to learning (like making sense of material, forming connections). If the AI does too much, there's a risk the learner's germane load diminishes – i.e., the learner might become a passive recipient of ready-made understanding instead of actively constructing understanding. CLT would suggest that we want to reduce extraneous load but maintain or even enhance germane load. The ideal use of NotebookLM, then, is not to eliminate the learner's effort, but to remove the unnecessary hurdles so that the learner's effort is spent on actual language acquisition and comprehension. For example, instead of struggling to decode every word (which is extraneous if one just needs gist), the learner can focus on understanding concepts (germane) because the AI provided definitions.

In practical terms, teachers might guide ELLs to use NotebookLM as a **second step**: first attempt reading (to train their skills), then use NotebookLM to clarify and summarize (to reinforce and ensure comprehension). This way, cognitive load during initial reading might be high (but trainable), and the AI reduces the load in the consolidation phase, which helps schema formation and automation of skills. Over time, as ELLs get stronger, they might need the AI less for simplification (intrinsic load tolerance increases) and only for efficiency or checking (extraneous load remains low).

To wrap up the theoretical view: **NotebookLM's design intuitively aligns with cognitive load theory by aiming to simplify and organize information, thereby optimizing the cognitive effort of ELLs towards learning rather than overcoming language barriers**. As one educational expert put it, clarity is king – reducing extraneous load is key to effective learning. If NotebookLM can deliver clarity (through summaries and answers), it could significantly improve ELLs' capacity to handle complex academic content in English, which in turn accelerates their language development and content mastery.

3.4 CALL Perspectives

While ZPD, SRL, and CLT give general educational insights, it's worth briefly situating NotebookLM in the context of **Computer-Assisted Language Learning (CALL) theories**. CALL research often evaluates tools based on how well they provide **input, output, feedback, and interaction**, which are core elements of SLA (Second Language Acquisition) theory.

- **Input and Comprehensible Input:** Stephen Krashen's theory emphasizes the importance of comprehensible input (i+1, just beyond current level). NotebookLM can help make input

comprehensible (as discussed via scaffolding). By translating i+1 input into i (current level) through summaries, it ensures learners get understandable English exposure. At the same time, because it's based on the original text, it hopefully retains some of the richness of authentic language (just presented in a digestible form). This aligns with CALL practice of modifying input (through glossaries, etc.) to help learners acquire language from content.

- **Output and Interaction:** Merrill Swain's output hypothesis suggests learners need to produce language to fully learn it. NotebookLM is not primarily an output-forcing tool (unlike a chatbot that makes learners write or speak). However, learners do interact with it through writing questions. Even that small output practice – phrasing questions in English – is an opportunity for language production. Some learners may also be prompted by the AI's notes to summarize aloud or paraphrase themselves as a way to double-check understanding (e.g., read the AI's summary, then try to express it in their own words without looking). The tool might indirectly encourage output if teachers integrate it (e.g., "Use NotebookLM to research a topic, then present it in your own words").

- **Feedback:** One of CALL's strengths is immediate feedback. While NotebookLM doesn't quiz learners in a typical way, it gives a form of feedback by answering their questions. If a learner's question is unclear (perhaps due to grammatical errors in how they asked it), the AI might give an off-target answer, implicitly signaling misunderstanding. Learners can then adjust their question – in doing so, they receive feedback on their language use clarity. Also, if a learner summarizes and then asks NotebookLM, "Is my summary accurate?" the AI's response (either confirming or adding details) serves as feedback on their comprehension. This kind of semantic feedback is quite novel and potentially very valuable for ELLs, who often don't get feedback beyond correctness of language form. Here, the feedback is on *content understanding*, which is just as crucial.

- **Learner Autonomy and CALL:** Modern CALL emphasizes empowering learners to take control via technology (as we discussed under SRL). NotebookLM fits well into an autonomous learning approach – it's a tool learners can use at their discretion to meet their immediate learning needs. It's not a prescribed lesson or drill; it's open-ended. According to constructivist CALL principles, such tools can be very effective if learners are trained to use them well, because they allow learners to construct knowledge (e.g., create their own understanding with AI help) rather than just receive it passively. The theoretical backdrop here includes Papert's constructionism (learning by making something – in this case, making a personalized notebook of knowledge).

To sum up, whether from a sociocultural angle (ZPD scaffolding), a cognitive-behavioral angle (feedback and load management), or a metacognitive angle (SRL), NotebookLM appears to have *sound theoretical backing* as a potentially beneficial tool for ELLs. It is positioned to scaffold learning within the learner's proximal zone, encourage active, independent learning habits, and reduce unnecessary difficulty, all of which are desirable in language education.

Armed with this theoretical understanding, we now move to concrete imaginative scenarios of how educators and learners might *use* NotebookLM for English language learning, and what benefits and pitfalls might arise in each case.

4. Proposed Potential Uses of NotebookLM in ELT

In this section, we propose several potential applications of NotebookLM in English language teaching (ELT) and learning. These use cases are hypothetical but grounded in the tool's described capabilities and the educational needs identified earlier. For each, we describe how NotebookLM could be utilized, illustrate with an example scenario, and consider the benefits and possible limitations.

4.1 Academic Reading and Vocabulary Support

Use Case: *Reading Comprehension Aids and Vocabulary Notebook.* One of the most straightforward applications of NotebookLM for ELLs is as a reading companion. When students are assigned challenging readings (articles, textbook chapters, literature) in English, they can use NotebookLM to generate summaries of each section, clarify difficult sentences, and compile a list of new vocabulary with definitions.

Scenario: Imagine a university ELL student, Yuna, who is taking an introductory Psychology course. The weekly readings are dense and full of technical terms. Yuna uploads the week's 20-page PDF into NotebookLM. She first asks, "Please summarize each section in 2-3 sentences." The AI produces a concise outline of the chapter, which gives Yuna a clear roadmap of the content. As she begins reading the first section, she encounters the term "operant conditioning." She types, "What does *operant conditioning* mean in simple terms?" NotebookLM responds with a brief definition and an example. She adds that to her notes. When a complicated paragraph appears, Yuna highlights it and asks, "Rephrase this paragraph more simply." The AI provides a simplified version, helping her grasp the meaning without getting lost in the complex syntax. Over the chapter, she collects 15 new vocabulary words that NotebookLM explained for her, essentially creating a personalized vocabulary list with context sentences. After reading, Yuna quizzes herself by prompting, "Give me a few questions to test my understanding of this chapter." NotebookLM generates questions, some of which she can answer, and one which she realizes she missed – prompting her to review that part.

Benefits: This use leverages NotebookLM's strengths in summarization and Q&A to *scaffold reading comprehension*. The student can engage with authentic materials slightly above their level (i+1 input) because the AI provides timely explanations and summaries to bridge the gap. It promotes active reading; instead of passively skipping unknown words or sentences, the student addresses them via questions. The compiled summaries and vocabulary effectively become a **study guide** the student can review later, reinforcing learning. Additionally, this approach can save time – rather than flipping through a dictionary and possibly getting multiple unrelated definitions, the AI gives context-specific definitions instantly, which studies show aids vocabulary retention (contextualized learning). It also ensures that misunderstandings are caught early: if the student misinterprets a section, the summary or Q&A can reveal that discrepancy, correcting comprehension.

Limitations: There are cautions to consider. **Monolingual bias**: NotebookLM currently operates in English, so all explanations are in English. For lower-level ELLs, an English definition might still be confusing. Yuna in our scenario seemed to handle it, but a beginner might have preferred a translation. If NotebookLM doesn't integrate bilingual support, beginners might struggle to formulate questions or understand answers entirely in L2 (English). Using it effectively might require at least an intermediate proficiency. Another issue is **over-reliance**: If Yuna started using the AI as a crutch for every single sentence, she might not try to infer meaning from context or develop reading stamina. Teachers should encourage strategic use – e.g., "try reading a paragraph on your own first, then use the AI for clarification." There's also a risk of **hallucination or error**: the AI might occasionally give a wrong explanation for a term (less likely for well-known terms, but possible). Students must be taught to cross-verify critical information, perhaps by checking the original text or other sources if something seems off. Finally, reading is also about critical thinking – if the AI summary is taken at face value, the student might not learn to analyze tone, bias, or deeper implications in the text. Educators could mitigate this by using the AI summary as a starting point for discussion: "Do you agree with this summary? Did it miss anything important?" Such reflective questions keep the student actively engaged rather than blindly accepting AI output.

4.2 Academic Writing and Research Support

Use Case: *Organizing Sources, Paraphrasing, and Citation Assistance for Writing.* For ELLs engaged in writing assignments (essays, reports, research papers), NotebookLM can serve as a helpful research assistant. Students can use it to digest academic sources, gather relevant quotes or ideas, get help with paraphrasing complex sentences in their own words, and even ensure they cite information correctly by tracking sources.

Scenario: Carlos, an advanced ELL in a graduate program, needs to write a 1500-word literature review on "AI in language education." He has collected five scholarly PDFs on the topic. Using NotebookLM, he creates a notebook and uploads all five papers. He first asks, "What are the main findings or points in each of these papers?" NotebookLM generates a brief summary of each source, complete with in-text citations or references from the PDFs. This gives Carlos a birds-eye view of the literature. Next, as he outlines his review, he decides to write about common themes across studies (e.g., chatbots in language learning, automated writing feedback, etc.). For each theme, he queries NotebookLM: "Find any evidence or quotes about chatbot effectiveness in these papers." The AI locates and presents a relevant excerpt from, say, a 2024 study (with a citation) stating the effect size of chatbot use. Carlos uses that quote in his draft (properly cited, thanks to the reference the AI provided). When writing, he struggles to paraphrase a particularly technical sentence from one source. He pastes the sentence and asks, "How can I paraphrase this in clearer academic English?" NotebookLM suggests a rewritten version that maintains the meaning. Carlos checks it against the original for accuracy, then adopts that phrasing, thereby improving the clarity of his writing while avoiding direct plagiarism. Finally, he uses NotebookLM to double-check his references: "List all the references from these sources in APA 7th style." The AI compiles a reference list (since it has the PDFs with bibliographies). Carlos cross-verifies and incorporates them into his paper's references section.

Benefits: NotebookLM in this context is like a *junior research assistant* for an ELL writer. It helps in organizing and synthesizing multiple sources – a task that can be overwhelming especially in a second language. By instantly retrieving key points and quotes, it reduces the cognitive load of skimming through many pages, allowing the student to focus on higher-order tasks like comparing arguments and critiquing studies. The paraphrasing support is particularly valuable for non-native writers: often ELLs resort to copy-pasting jargon or overly complex sentences from sources because they aren't confident in rewording them. With AI suggestions, they can learn how to express the idea in simpler terms. This also can improve their academic writing style over time as they see examples of well-phrased sentences. Citation assistance ensures they give credit properly – a critical skill (and one that ELLs sometimes falter in if citation rules are unfamiliar or they translate titles incorrectly, etc.). Overall, using NotebookLM for writing can speed up the research process and help ELL students produce work that meets academic standards of clarity and evidence.

Limitations: A major ethical and educational concern here is **plagiarism and originality**. If misused, a student might lean on the AI too much – for example, taking AI-generated paraphrases or summaries without fully processing them, or even asking the AI to *write* sections of the paper (beyond just summarizing sources). That crosses into academic dishonesty if not disclosed. It's a fine line: getting help paraphrasing one sentence might be okay (akin to asking a writing center tutor for help), but having AI generate an entire paragraph is not the student's own work. Educators will need to set guidelines for acceptable use. One approach is transparency: encourage students to document how they used the AI (e.g., "I used NotebookLM to generate a summary of Jones (2023) which I then refined"). This way it's a learning tool, not a cheating shortcut. Another limitation is accuracy: the AI might misattribute a quote or mix up authors if multiple sources say similar things (though NotebookLM's citation tracking is supposed to prevent hallucinating sources). Carlos should still cross-check quotes in the original PDFs. The **over-reliance** aspect also matters: writing is a skill improved by practice. If the AI did all paraphrasing, Carlos wouldn't be improving his own ability to manipulate language. A balanced use would be to use AI paraphrase as a suggestion and then try to refine it himself. Additionally, nuance might be lost – AI summaries might miss subtle differences in studies or the author's stance, which a critical literature review should capture. So while NotebookLM can handle the heavy lifting of summarizing, the student must still engage critically with the material. Teachers could mitigate misuse by requiring reflective annotations like "Explain in your own words how the AI's summary aligns or differs from your understanding." This ensures the student isn't just copying from AI outputs.

4.3 Personalized Language Practice and Autonomy

Use Case: *Autonomous Language Practice and Study Material Generation.* NotebookLM can empower ELLs to create personalized study materials and engage in self-directed language practice. Students might use it to generate practice exercises, conversational prompts, or even translations, thus customizing their learning outside class.

Scenario: Wei is an ELL who wants to improve his business English. He has a textbook from his Business English class and also reads news articles on economics. Wei uses NotebookLM in a creative

way: after reading a news article about tech markets, he asks the AI, "Give me a summary of this article and then five questions I should answer about it." The AI provides a summary and questions (like comprehension questions or discussion prompts). Wei writes down his answers to the questions, then asks the AI to check if his answers cover the key points (essentially, he's using it as a rudimentary tutor to verify his comprehension responses). In another session, Wei wants to practice *writing emails* in English – he types a draft of a formal email to a client and asks NotebookLM, "Can you review this email for tone and clarity?" The AI points out a couple of awkward phrasings and suggests more polite wording. Wei learns from this feedback and revises accordingly. He also uses NotebookLM to **create cloze exercises** for himself: he inputs a paragraph from his textbook and asks the AI to remove some keywords and create a fill-in-the-blank exercise. This gives him a quick worksheet to practice key vocabulary recall. Over weeks, Wei builds a personal "notebook" of these exercises, summaries, and corrected writings. This independent work, aided by AI, supplements his classroom learning and targets exactly the skills and topics he personally needs to work on.

Benefits: This scenario highlights NotebookLM's role in fostering *learner autonomy* and tailoring learning experiences. By generating custom exercises (questions, cloze tests, prompts), the AI helps the learner extend their practice beyond what is available in textbooks. Personalization is key: Wei is essentially co-designing his practice with the AI, focusing on his interest (business news) and needed skill (email writing). The immediate feedback on writing (tone, clarity) is something that traditionally only a human teacher could give, and even then not on demand. AI can fill that gap for writing practice done at home – it's like having a writing coach available at any time. For speaking, although not explicitly in this scenario, one could imagine a student using NotebookLM to generate a dialogue or role-play script on a chosen topic and then practicing it. The variety of uses is large; importantly, it puts the *learner in control*. Autonomy is strongly linked to motivation; a student who can pursue their own interests in English with some AI help is likely to be more motivated than one who only does prescribed workbook exercises. It promotes a sense of ownership – Wei is essentially making his own learning materials. This aligns with pedagogical movements towards learner-centered curricula and self-access language learning, where learners choose resources and activities that suit their goals (here, the AI is an all-in-one resource generator).

Limitations: Autonomy requires ability to self-regulate (as discussed in SRL) – not all learners may utilize the AI effectively without guidance. A risk is that some might misuse it (e.g., ask the AI for answers rather than practicing). For example, Wei could have just asked the AI for the answers to the questions it generated, which would defeat the purpose. Teachers might need to teach strategies for using the tool constructively: like "use it to create exercises, but attempt them yourself before checking." There's also the accuracy issue of AI feedback: while NotebookLM can critique tone or grammar in writing to an extent, it might miss context nuances or prefer a style that the teacher might not. There's also **no human judgment** – e.g., the AI might say an email is polite enough, but maybe culturally it still sounds off to a native speaker. So AI feedback should be taken as suggestions, not absolute truth. Another limitation is that NotebookLM is not a conversational chatbot (it doesn't keep a multi-turn conversation going like ChatGPT in the same way), so using it for speaking practice is not as straightforward as using an interactive chatbot. It could generate dialogues but won't simulate

a live conversation beyond Q&A about a document. For true speaking practice, voice-AI or language exchange might still be needed. Moreover, **motivation** might wane if the AI interactions are too mechanical. Some learners enjoy gamified apps (like Duolingo's points and levels) – NotebookLM is more open-ended and not inherently gamified. Highly self-motivated learners like Wei benefit, but less motivated ones might not engage without teacher scaffolding or goal-setting.

4.4 Classroom Integration and Collaboration

Use Case: *Classroom Projects and Group Work Enhancement.* Teachers could incorporate NotebookLM into classroom activities to support group projects, reading circles, or research assignments. In a collaborative setting, multiple students might use NotebookLM together to gather information or verify answers, thereby learning from both AI and each other.

Scenario: In an advanced ELL reading class, the teacher assigns a *jigsaw reading* activity: each group gets a different article about climate change and will teach the class about it. One group of three students has a lengthy article. They decide to use NotebookLM collaboratively. One student uploads the article and the group brainstorms what the main ideas are. They then ask NotebookLM to "List the key points of each section of the article." The AI outlines the article, and the students compare it with their own initial notes – it turns out they missed a couple of points, which they then discuss and add. Next, each student takes a subsection to explain. One student is unsure about a complex paragraph in her subsection, so she uses NotebookLM to simplify it, then confidently puts it into her own words for the upcoming presentation. Another student formulates a comprehension quiz question for the class and even checks with NotebookLM if the answer is clearly present in the text (to ensure it's a fair question). During their presentation, the group uses the AI-generated outline as a handout for classmates. In a different class, a teacher might allow students to use NotebookLM during **independent work time** – for instance, if students are doing a webquest or project research, NotebookLM could be one of the tools at a station to help them find information or summarize findings, much like having an encyclopedia or tutor on hand.

Benefits: In-class use of NotebookLM can scaffold learning tasks that would otherwise be too difficult or time-consuming for ELLs, thereby enabling more complex or authentic activities. The jigsaw reading example shows how AI can help ensure *no group is left behind*: normally, if one group's text was harder, they might fail to grasp it fully and then not be able to share with the class. With AI support, they can fill their comprehension gaps and deliver a complete report. This fosters a more equitable learning environment. It also demonstrates **peer-AI interplay**: students had a chance to discuss among themselves and then verify or supplement with AI, which combines human collaboration (valuable for learning communication skills) with AI accuracy/coverage. Using NotebookLM as a collaborative tool can also teach critical thinking – students might debate if the AI's identified key points are indeed the most important, fostering higher-order thinking. Additionally, it can save classroom time. Instead of groups spending the entire time deciphering the text, they quickly clarify it and spend more time on the pedagogical goal (e.g., practicing summarization or presentation). It basically offloads some lower-level decoding so that class time can focus on discussion, analysis, or practicing speaking – more productive uses of limited classroom hours.

Limitations: Introducing AI in class raises some challenges. Teachers must ensure it doesn't become a crutch or an easy way out. For example, will students skip trying to read at all and just rely on summaries? To prevent this, teachers might structure tasks so that AI is a second step, not the first. There's also the risk of **misinformation**: if NotebookLM ever produced an inaccurate summary, students might present wrong info to the class. The teacher needs to monitor or have students verify critical facts. Another concern is that not all students might have equal access or skills in using the AI. In group work, perhaps one student monopolizes the tool (the tech-savvy one) while others disengage. Teachers should assign roles (like one student operates the AI, another cross-checks it, etc.) to involve everyone. There's also a technical aspect: classroom use requires devices and internet – not always available or reliable in all contexts. From a pedagogical stance, teachers have to adapt their plans: if AI gives answers quickly, tasks need to be deeper to remain challenging (e.g., moving from comprehension to application or critique). Finally, some educators worry that reliance on AI could hinder learning fundamentals (e.g., dictionary skills or inferring meaning from context). It will be important to strike a balance, perhaps by sometimes disabling AI use to ensure students can still perform without it when needed (like in exam situations or real-life scenarios without AI).

4.5 Limitations and Cautions in Use

In each use case above, we noted specific limitations. Here we consolidate some general limitations of NotebookLM for ELL support:

- **Monolingual Bias & Language Limitations:** If NotebookLM only works well with English input/output, beginners who need L1 support or translation may not benefit fully. It's primarily an English-medium tool. (However, as noted, its *Audio Overview* feature expanded to many languages blog.google, which could hint at future multilingual capabilities).

- **Accuracy and Trustworthiness:** As with any AI language model, NotebookLM can occasionally produce incorrect information or misinterpret a query. ELLs might have difficulty spotting these errors due to limited language proficiency or content knowledge. This could lead to learning incorrect facts or nuances. Therefore, using it for high-stakes information (like important facts or definitions) should come with cross-verification from trusted sources whenever possible. In language learning, a subtle risk is if the AI's rephrasing is slightly "off" in tone or usage – students might unknowingly adopt that. Educators should encourage a healthy skepticism: "AI is a tool, not an authority."

- **Over-Reliance & Skill Atrophy:** The biggest pedagogical concern is that over-reliance on NotebookLM might prevent ELLs from developing certain skills. If a student always uses AI to summarize, they may not practice summarizing themselves (missing out on the language production and cognitive benefits of that exercise). If they always ask AI for word meanings, they might not develop inference from context or memory retention of vocab as strongly as looking it up and actively noting it themselves might. Teachers should design activities that sometimes *remove the scaffold* to gauge if students can perform without it, gradually building independence (similar to how training wheels are eventually taken off a bicycle). Over time,

ideally, ELLs use NotebookLM for higher-level support but can still do fundamental processes on their own.

- **Ethical and Academic Integrity Issues:** Especially for writing support, there is a fine line between assistance and cheating. Without clear guidelines, students might inadvertently cross into inappropriate use – e.g., using AI-generated text verbatim in an assignment. Academic institutions and teachers will need to set policies about AI usage (some already include statements in syllabi like "AI tools may be used for proofreading or brainstorming but all submitted work must be your own"). The ethical use of AI needs to be taught, including issues of plagiarism, transparency, and when it's not allowed (exams, certain assignments). For ELLs, this clarity is crucial to avoid punishments due to misunderstanding the norms.

- **Data Privacy:** Using NotebookLM involves uploading potentially sensitive documents (like student essays, or articles that might be copyrighted). There might be privacy concerns if students upload personal reflections or if a school has policies about student data. Google's policies would need to be understood – teachers should ensure students aren't uploading anything confidential. From a student perspective, their interaction data might be stored; some may be uncomfortable not knowing who can access it. Clear privacy assurances or opting out options should be in place. Schools might also require parental consent for students to use such tools, particularly if under 18.

- **Technical Constraints:** Not a theoretical issue, but practically – if internet is down or the service has usage limits, reliance on it could backfire at a crucial moment. Also, currently NotebookLM is not universally available (it started as a limited trial in the US). So adoption can be slow.

In light of these limitations, the hypothetical examples assume ideal conditions of use. Real-world implementation would need addressing these concerns through teacher guidance, student training on how to learn *with* AI (not just from AI), and ongoing monitoring of effectiveness. Despite these caveats, the potential use cases show that if managed well, NotebookLM could complement traditional teaching and independent study in valuable ways for ELLs. Next, we will discuss overarching implications and what unknowns remain, to temper the optimism with a realistic outlook.

5. Discussion

The above exploration paints an optimistic picture of NotebookLM's potential to support English language learners. In theory, NotebookLM can scaffold ELLs in reading, writing, and self-study, aligning with solid pedagogical principles (ZPD, SRL, etc.). However, it is crucial to balance this *promise* with the many *unknowns* and possible pitfalls identified. This discussion synthesizes those points, examining the broader implications, and outlines a research agenda to move from speculation to evidence. We also consider the ethical and practical challenges of introducing such AI tools in education, and what that means for teachers and curriculum designers.

Promise vs. Current Unknowns: On the promising side, NotebookLM represents a new generation of AI that is context-aware (it uses the user's own documents) and interactive. Unlike generic chatbots,

it grounds responses in provided sources, which is ideal for educational settings where factual accuracy and relevance to the curriculum are important. If the theoretical benefits hold true, ELLs using NotebookLM could experience improved comprehension of complex texts, more efficient studying, and greater confidence in handling English materials on their own. The tool could be a *game-changer* for independent learning, much like calculators were for math – handling tedious parts so learners can focus on higher-level skills. However, we must acknowledge that these benefits are *hypothesized*. The current reality is that no empirical data is available yet on ELL outcomes with NotebookLM. It's entirely possible that in practice some benefits are less pronounced or offset by new issues. For instance, maybe students get through readings faster but retain less because they relied on summaries (just as some fear GPS navigation tools weaken our own navigation skills). Or perhaps students love using it initially, but novelty wears off and it doesn't significantly change their long-term habits. We simply don't know until research is conducted.

Another unknown is *usability*: will ELLs find the interface intuitive? Will they know what questions to ask? There could be a learning curve in learning how to interact effectively with the AI to get good results, and not all learners may figure that out without training. In addition, differences in learner profile (age, proficiency, tech-savviness) might significantly affect outcomes. A tool that works well for a college student might confuse a middle school ELL. These nuances underscore that our optimistic use cases might need fine-tuning per context.

Risk of Overhyping Untested Tools: The educational technology field has a history of hype cycles – a new tool emerges with grand claims (sometimes from the companies themselves), early adopters get excited, but then either research fails to find strong effects or implementation issues lead to disillusionment. We've seen this with things like language labs, certain intelligent tutoring systems, or MOOCs – all heralded as revolutionary, yet their actual impact was limited by various factors. NotebookLM, being a Google product with significant media attention, could easily be overhyped. Enthusiasts might start calling it a "personal AI tutor for every student" before any evidence. This is dangerous because it can lead to schools spending resources or changing curricula to incorporate a tool that might not deliver proportional benefits, or that only works under certain conditions.

We should thus approach NotebookLM with **critical optimism**. It's okay (even good) to be excited about the potential – after all, it addresses real pain points in language learning. But educators and administrators should demand evidence and conduct pilots rather than mandating its use outright or assuming it will automatically improve outcomes. Overhyping also brings the risk of under-preparing: if everyone believes the tool is plug-and-play magic, they might not put effort into teacher training or addressing drawbacks. In truth, as we have argued, **the tool's effectiveness will likely depend on thoughtful integration** and oversight.

Another subtle risk of hype is *teacher resistance*. If a tool is overhyped by external sources, teachers on the ground might be skeptical or see it as a threat to their expertise. It's better to approach it as "here's a new option that, with your professional input, could enhance learning" rather than "this AI will replace some of your teaching." Keeping expectations realistic will facilitate more open adoption and experimentation.

Ethical Concerns: Data, Bias, Misinformation: Ethics must be front and center when introducing AI in education. First, data privacy: NotebookLM involves data uploading and possibly storing student-AI interactions on Google's servers. Schools and universities will need to consider FERPA (in the US) or GDPR (in Europe) and other regulations. Sensitive student information should not be uploaded. If NotebookLM is used with minors, parental consent and transparency about data use are essentialjier.org. Institutions might push for agreements that any data is not used to further train models without permission, etc. These are administrative but important details to sort out before large-scale use.

Bias is another ethical issue. AI models like the ones behind NotebookLM are trained on large datasets that include societal biases (e.g., maybe fewer texts from certain cultures or languages). This can reflect in output. For example, a study highlighted that AI detectors misclassified non-native English writing as AI-generated due to bias in what is considered "good English". While that's a specific case, it shows AI can inadvertently penalize or misinterpret ELLs. In NotebookLM's context, perhaps it might summarize differently based on writing styles of authors from different backgrounds. Also, if an ELL asks a question with slightly incorrect grammar, the AI might misinterpret it – not exactly bias, but a limitation in handling non-standard input. It's crucial to examine how the tool performs for ELL-specific language (like interlanguage errors). Additionally, any content-related biases (e.g., if it tends to foreground Western perspectives in summaries if sources are diverse) should be considered in a classroom where critical thinking about sources is taught.

Misinformation and hallucination (the AI making up info) could be particularly problematic in an educational setting. If a student relies on NotebookLM for factual info and it provides an incorrect reference or misquotes an author, the student might spread that false info in assignments or discussions. Teachers must thus inculcate information literacy: students should verify critical information through multiple sources. One advantage is that NotebookLM uses provided documents, which should limit wild hallucinations; it's more anchored than a general chatbot. Even so, it might still misattribute or summarize inaccurately.

The Human Element & Teacher Role: One theme emerging is that **NotebookLM is a tool, not a teacher**. It lacks the pedagogical judgment, empathy, and adaptability of a human teacher. It will answer what it's asked, but it won't spontaneously diagnose a misconception like a skilled teacher could, nor provide encouragement or tailored scaffolding beyond what is prompted. Therefore, teachers remain essential in guiding the use of such AI. The teacher's role might shift more towards a facilitator or coach when AI handles some direct instruction (like explaining vocabulary), but arguably that makes teachers even more important to ensure that learning is happening meaningfully and that students are thinking critically.

For example, a teacher might plan a lesson where initial comprehension is aided by NotebookLM, but then the teacher leads a discussion probing deeper inference or critical analysis – areas where human guidance is key. Also, teachers would need to resolve any confusion from AI outputs and help students interpret them. Educators and curriculum designers should see NotebookLM as *augmenting* their

toolkit. It could free up class time from rote activities (like going over reading comprehension of a text line by line) and allow more practice, application, and personalized help.

Research Agenda – What Next? To move from theory to evidence, several types of studies are needed:

- **Pilot Implementation Studies:** Small-scale implementations in actual classrooms or with volunteer students, documenting how they use NotebookLM and what issues arise. Qualitative data (student and teacher feedback) would be invaluable initially. For instance, does using NotebookLM for reading homework lead to richer class discussions? Do students feel it helps them learn or just get the work done faster? Are there any patterns in errors or misunderstandings when using it?

- **Effectiveness Experiments:** Controlled studies comparing ELLs using NotebookLM versus a control group not using it (or using traditional supports) on various outcomes: reading comprehension scores, writing quality (perhaps blind-rated essays), vocabulary retention tests, etc. This will give a quantitative measure of impact. It would be important to measure not just immediate performance (did they understand a text), but also retention (do they still recall content or vocab later?) and skill transfer (can they summarize a new text without AI later?).

- **Process and Interaction Analysis:** Logging and analyzing how learners interact with NotebookLM – what kinds of questions do they ask? Where do they give up or misuse it? This can identify training needs. Maybe logs show many students asking overly broad questions and getting unsatisfactory answers; teachers could then instruct on asking better, specific questions. Or perhaps logs reveal that students ignore the AI's citations – indicating a lack of understanding of their purpose, which again is an instructional moment.

- **Different Proficiency Levels:** Research should consider beginner vs intermediate vs advanced ELLs. It's plausible that advanced ELLs gain the most (since they can engage with it fully in English and use higher-order features), whereas beginners might find it less accessible. Studies focused on each level can refine how to adapt the tool or wrap support around it (like perhaps integrating it with bilingual dictionaries for lower levels).

- **Teacher Adoption and Training:** Another line of research is investigating teacher attitudes and effective training methods. If teachers aren't comfortable or don't see value, they won't implement it. Studies could look at professional development interventions on using NotebookLM and the resultant change (or not) in classroom practices. Also, what challenges do teachers face (technical, classroom management, aligning with curriculum, etc.)?

- **Longitudinal Impact:** If ELLs use NotebookLM regularly over a term, does their approach to learning change? For better or worse? For instance, do they become more independent and curious (positive) or more lazy in reading full texts (negative)? Longitudinal studies could catch such trends, which short experiments might miss.

For Educators and Curriculum Designers: In the immediate term, those designing curriculum or tech integration plans should proceed thoughtfully. It might be wise to start with *optional or supplementary* use of NotebookLM – for students who want extra help, or as part of a learning center – rather than making it mandatory from day one. This way, keen students benefit and also serve as a test group. Their experiences can inform wider adoption. Curriculum designers should consider developing **guidelines or lesson plans** that incorporate NotebookLM in pedagogically sound ways. For example, a reading lesson plan might explicitly say: "After individual reading, students may use NotebookLM to verify their answers, then discuss discrepancies in groups." By embedding it in the design, it becomes a purposeful tool, not an add-on.

Additionally, educators should emphasize to students the goal of using such AI: it's to help you learn better, not shortcut the learning. That messaging and framing matters. Some students might think using AI is "cheating" if not clarified; others might think it's an officially sanctioned way to do less work. Clear expectations (perhaps a classroom AI use policy co-created with students) can address this.

Relevance and Equity: We should also discuss who benefits and who might be left out. If NotebookLM or similar tools prove beneficial, ensuring *equitable access* becomes an issue. Wealthier schools or students with personal laptops could integrate it easily, while under-resourced settings might not. This could widen achievement gaps if not addressed. Policymakers and institutions might need to invest in the necessary tech infrastructure or provide alternatives (though frankly, AI like this may be hard to replicate without a machine). Possibly, special programs or after-school resources could offer AI access to those who don't have it at home. Another equity dimension is language – currently it's for English learning; similar tools for other languages are emerging, and sharing knowledge across languages is important so that it's not only English learners who get advanced AI support, but learners of other languages too.

Environmental and Economic Factors: Slightly tangential, but some discussion in AI in education points out cost and sustainability. Will NotebookLM remain free? It already introduced a paid version for premium features. If AI in education becomes subscription-based, schools have to consider budgeting, and it may advantage those who can afford it. Also, AI computation has environmental costs (energy use); large scale adoption means we should consider those, though that's beyond this paper's direct scope, it's part of the broad conversation on responsible AI deployment.

In conclusion of this discussion, we maintain that NotebookLM *could be* transformative – an assistive technology enabling a form of personalized, immediate support that was previously unavailable to ELLs. But realizing that transformation depends on careful, critical implementation and systematic inquiry into its actual effects. The worst-case scenario would be either blindly adopting it and facing negative consequences, or rejecting it due to fear and missing out on potential benefits. The balanced path is experimentation with careful monitoring.

6. Conclusion

This theoretical exploration set out to answer whether NotebookLM could meaningfully support English language learners, and if so, in what ways. Drawing upon established research on AI in education, cognitive strategies for learning, and language acquisition theory, we have argued that **NotebookLM holds significant potential as an assistive tool for ELLs**, provided it is used thoughtfully.

NotebookLM's ability to generate summaries, explanations, and answer questions based on user-provided texts aligns strongly with the needs of language learners: it can scaffold complex readings by simplifying them, supply instant vocabulary and grammar help, and act as a tireless tutor for reviewing and practicing material. From a Vygotskian perspective, it offers a form of scaffold in the learner's zone of proximal development – giving support just beyond the learner's independent ability so they can reach new levels of understanding. Through the lens of self-regulated learning, it encourages autonomous study habits: learners can set goals (e.g. understanding an article), use strategies with AI assistance (summarizing, questioning), and get immediate feedback to adjust their learning. Cognitive load theory also supports its use, as the tool can reduce extraneous load by organizing and condensing information, allowing learners to focus on core learning tasks. In essence, NotebookLM can serve as a *personalized learning companion*, helping ELLs navigate English content and tasks that might otherwise be overwhelming.

We presented hypothetical use cases – from reading and writing support to vocabulary practice and collaborative projects – to illustrate concretely how ELLs and teachers might integrate NotebookLM into learning activities. These scenarios were optimistic, showing improved comprehension, efficiency, and confidence in learners who leverage the tool. However, we also critically examined limitations: the risk of over-reliance, the need for a certain proficiency to use it effectively, possible inaccuracies or biases in AI output, and ethical concerns like plagiarism and privacy. These cautionary points underscore that **NotebookLM is not a magical solution**; it is a powerful tool whose impact depends on the context and manner of use.

At this juncture – with NotebookLM still novel and unresearched in classrooms – we can conclude that it is *potentially transformative* for ELL education, but that transformation is conditional. It will require educators to approach the tool with "critical optimism," embracing its benefits while actively mitigating its downsides. Initial trials and pilot studies should be encouraged, and their findings openly shared, so the education community can learn what works and what doesn't. Crucially, extensive empirical research (as outlined in the Discussion) is needed to validate the theoretical advantages we've discussed. Stakeholders should support such research, as the insights will guide effective implementation or highlight necessary adjustments (perhaps even informing developers on educational feature needs).

If evidence confirms even a portion of NotebookLM's theoretical benefits, we could see a shift in ELL pedagogy: more flipped classrooms (with AI helping at home and class time for interaction), more differentiated instruction (students working at their own pace with AI help), and greater learner independence in acquiring language and content. ELLs who might have been left behind due to

language barriers could better keep up with mainstream content by using AI support as a bridge. That said, no AI should replace the human elements of motivation, encouragement, cultural understanding, and interactive communication that are central to language learning. The goal is augmentation, not substitution.

In closing, we reiterate the call for **empirical research and careful integration**. NotebookLM and similar AI tools herald a new era in which personalized, AI-driven support is available to learners. This is exciting and a little daunting. Educators and researchers must collaborate to ensure these tools are used to *enhance* learning rather than shortcut it. By doing so – by staying critical yet open-minded – we can harness NotebookLM as a catalyst for better learning outcomes for English language learners. The theoretical perspective offered in this paper is an early stepping stone; the next steps will determine the real impact of AI notebooks in education. Let us proceed with curiosity, rigor, and a commitment to empowering learners.

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