The Efficacy of Notebook LM for Improving Content Knowledge in Agricultural Education: A Comparative Study of Undergraduate and Graduate Learners

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Introduction

Artificial Intelligence (AI) is defined as "the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages" (Chassignol, 2018, p. 17). The rapid integration of AI into educational systems is transforming both pedagogy and administration, with applications focused on improving operational efficiency and enhancing personalized learning experiences (Bhutoria, 2022; Kamalov et al., 2023).

Educators increasingly rely on AI technologies to reduce the time spent on repetitive tasks, allowing them to focus on higher-order teaching and relational engagement. Automated grading and feedback systems, for instance, deliver immediate and objective performance data to students while easing the workload of instructors (Nemani, 2025).

Generative artificial intelligence is transforming both instructional design and educational management. Tools such as Google's NotebookLM, powered by the Gemini model, enable advanced notetaking, document analysis, and content creation by allowing users to upload materials, pose questions, and receive AI-generated summaries, explanations, and audio overviews that enhance accessibility. These technologies promote personalized learning, collaboration, and research efficiency while supporting educators in developing adaptable lesson plans and assessments, thereby strengthening their role as facilitators of learning (Trust et al., 2025; Lu et al., 2024). Beyond the classroom, AI enhances institutional operations by improving scheduling, reporting, and data-driven decision-making (Dai et al., 2024; Deep, 2024). From K–12 to higher education, applications such as teaching robots, intelligent tutoring systems, and adaptive learning programs illustrate AI's expanding role in shaping modern education (Chassignol, 2018).

How it works/methodology/program phases/steps

In Fall 2025, Notebook LM was introduced within an online course curriculum to function as a supplementary tool, aiming to increase the potential for deeper knowledge acquisition and retention of the course material. Its grounded reasoning guarantees output is verifiable and highly reliable, as all information is exclusively sourced from the user's private documents. Supplementary resources for this stage of Notebook LM inclusion included podcasts and audio-video overviews. Resources were included in the web-based learning management system Canvas to serve as an additional learning resource to support the material in the module of instruction.

Results to date/implications

Notebook LM was used to develop study materials for two different classes, one undergraduate and one graduate. The following themes emerged from the undergraduate course: Improved understanding and retention, support for different learning styles, flexibility and convenience,

increased engagement and enjoyment, accessibility and inclusivity, and positive perception of innovative teaching. Students consistently said the podcasts and videos made the lesson easier to follow and clearer. The real-world examples and conversational explanations enhanced the online class content. One student said “Listening to key ideas in conversation from rather than just reading them helps me retain information better and see how concepts connect in real-world contexts. comprehension compared to just reading the PowerPoint slides. Undergraduate students stated “since this is a fully online class, it helped me engage with content better” and it made the course less monotonous and more motivating. One student even mentioned listening and watching the videos helped them with their dyslexia and made the content easier to understand.

From the graduate course the following themes emerged, bridging theory and practice, reinforcement of core research skills, accommodation of diverse learning styles, flexibility and convenience, and pedagogical innovation and advocacy. Students appreciated hearing complex concepts explained conversationally in the AI podcast, and it helped “make challenging topics easier to understand by connecting theory to practical examples”. Students also stated that it helped fill in the gaps from reading-heavy material, they felt “having the audio and visuals available helped them get that extra information that I may not have retained while reading the chapters”. Between both classes the overall tone was appreciate, stress relieving, and helpful to make classes more engaging and enjoyable.

Future plans and advice for others

Future plans for the utilization of Notebook LM in a University Learning Management System (LMS) will include both practical and research-based practices. Future use as a course resource tool will include additional resources Notebook LM has to offer, including quizzes, study guides, and material summaries. Additionally, course materials will utilize a Blog Post resource for a more informal method of material reinforcement. Learning outcomes, along with accreditation standards for different disciplines, will be used to support the different specific resources that will be developed. Further inquiry into how Notebook LM can increase student motivation and engagement will be completed through student course surveys.

Costs/resources needed

The integration of Notebook LM as a learning resource into an LMS for private use is currently free but limited for those with a Google Workspace account. For advanced notetaking and research capabilities, Notebook LM Pro offers an enhanced version for around $20.00 a month, dependent on what tier service is purchased. Alongside this pricing structure, those with a Google One AI Premium subscription are provided the service as a part of that subscription, offering advanced features and functionality. Aligned with future plans of expansion of the resources and enhanced capabilities, such as 5x more audio overviews and customization options.

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