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Utilizing Language-Generating Artificial Intelligence in Educational Planning: A Case Study

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Abstract

This case study explores the integration of language-generating artificial intelligence (LGAI) in K-12 instructional planning, focusing on a middle school science teacher's use of these tools within the Technological Pedagogical Content Knowledge (TPACK) framework. The study investigates two primary concerns: how LGAI is utilized for lesson planning and its impact on the structure and content of lesson plans. The findings indicate that LGAI tools can assist in personalizing learning materials, enhancing the teacher's efficiency, and supporting real-time instructional adjustments. However, the effectiveness of LGAI is heavily reliant on the teacher's engagement and knowledge, including refining AI outputs and aligning them with pedagogical goals. The study emphasizes the potential for LGAI to transform educational practices, but it also underscores the need for further research on teacher training and the long-term impacts of AI integration in diverse educational contexts.

Keywords: *Generative AI in Education, Instructional Planning, TPACK Framework*

Before the early 2020s, artificial intelligence (AI) in education was typically confined to specific, narrowly defined tasks. However, the emergence of Generative AI (GenAI)—a type of AI that can create new content, such as text, images, or audio, by learning from vast datasets—has significantly broadened this scope. Tools like ChatGPT, a conversational model developed by OpenAI, exemplify GenAI's potential by generating human-like text based on vast amounts of data, enabling interactive dialogue that can support learning, problem-solving, and other

educational tasks. These systems exhibit technological sophistication and versatility in cognitive reasoning, problem-solving, and learning but do not replicate human intelligence. Instead, they simulate aspects of cognitive functions. This shift from specialized functions to more generalized capabilities signifies a technological evolution and a potential redefinition of instructional planning.

While GenAI has progressed rapidly and shows potential to transform educational practices, its integration into teaching remains underexplored. Focused research is needed to understand how these technologies can enhance instructional planning and support diverse learner needs, especially in resource-limited environments. In response to this need, this study explores the integration of language-generating artificial intelligence (LGAI) within K-12 instructional planning, using the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) as a guiding lens. The research focuses on a case study involving a middle school science teacher, providing a practical context for understanding how LGAI tools can enhance the intersection of technology, pedagogy, and content knowledge. This study aims to offer a nuanced understanding of LGAI's potential and its implications for instructional design, seeking to provide insights that educators can harness to improve educational outcomes.

The following research questions guide this study:

1. How is LGAI utilized in educational activity planning by middle-grade teachers?
2. What impact does LGAI integration have on the structure and content of lesson plans?

These questions are designed to explore both the practical application and the broader instructional implications of LGAI integration in a classroom setting.

Literature Review

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The integration of language-generating artificial intelligence (LGAI) into education has garnered increasing attention. Research indicates that effectively leveraging these technologies depends on a variety of factors, including teacher engagement, knowledge, and the specific strategies used. This review will examine the practices necessary for strong educational outcomes with LGAI, focusing on the knowledge needed and the specific engagement strategies teachers must employ, as well as the importance of professional development.

Teacher Engagement with LGAI

Engagement is crucial for successfully integrating LGAI into classroom practices. While LGAI can generate lesson plans and instructional materials, it is the teacher's role to refine and adapt these outputs to specific contexts (Zhu et al., 2023). Teachers must critically evaluate LGAI-generated content to ensure it aligns with pedagogical goals and student needs (Van Den Berg & Du Plessis, 2023). Although LGAI creates acceptable lesson plans, teacher intervention is required to ensure they are effective in practice.

Teacher Moves to Achieve Desired Outputs

For LGAI to be effective in education, teachers must employ specific strategies. Defining clear objectives, creating specific prompts, and refining AI-generated content are key to ensuring relevance and accuracy (Liang et al., 2023). Balancing human interaction with AI support ensures educational goals are met (Mohamed, 2024).

Professional Development for LGAI Integration

Ongoing professional development is essential for ensuring teachers can navigate the complexities of LGAI tools. Professional development programs are vital for equipping teachers with the skills needed to engage effectively with LGAI (Evmenova et al., 2024). Training programs should focus on both the technical skills needed to use LGAI and the ethical

considerations that come with its use (Zhu et al., 2023). Equipping teachers with these skills will enable them to integrate LGAI effectively into their teaching practices.

Framework

The successful integration of LGAI into educational settings requires a nuanced understanding of the interplay between technological, pedagogical, and content knowledge (TPACK) and a deep familiarity with the specific contexts in which education occurs (Mishra et al., 2023). This broader perspective is crucial as we advance towards a more integrated AI-TPACK framework that includes AI-specific strategies and underscores the necessity for knowing and understanding student characteristics and educational environments. Technologies like AI can impact the educational landscape. However, they operate within existing social structures and must be understood as part of a broader ecosystem that influences and is influenced by these tools (Mishra et al., 2023). Mishra et al.'s (2023) metaphor of generative AI as a "smart, drunk intern"—imperfect yet capable of assisting with complex tasks and contributing to the learning environment through its knowledge base and processing capabilities—is apt. Educators must also be aware that participating in co-creative LGAI processes can reshape both the user and the technology (Mishra et al., 2023, p. 8).

Building on the TPACK foundational framework and considering generative AI capabilities, several researchers have proposed enhancements to adapt TPACK to integrate AI technologies (Celik, 2023; Ning et al., 2024). Recognizing AI's unique challenges and opportunities, they advocate for developing AI-specific technological and pedagogical knowledge and emphasize the necessity of including ethical considerations. This extended AI-TPACK framework could lead to more responsible and effective AI integration, ensuring educators are proficient in using AI tools and critically assessing their implications.

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This study employs the AI-TPACK framework as a lens to guide data collection and analysis. It helps examine how LGAI is integrated into instructional planning and its impact on lesson structure and content. By applying this framework, I aim to assess how the use of LGAI interacts with technology, pedagogy, and content knowledge in educational contexts.

Methods

Research Design

This study employs a single-case study design to facilitate an in-depth investigation of processes and results within their natural environments (Yin, 2014). This approach is particularly effective in educational settings where understanding the nuances of technological integration, such as LGAI in lesson planning, requires a detailed examination of individual cases. This method highlights the narrative power of case studies to convey personal experiences and contextual dynamics involved in educational innovations (Stake, 1995). The focused approach of a single-case study generates detailed insights that are often overlooked in broader studies, forming a basis for generating hypotheses and broader applications in subsequent research (Flyvbjerg, 2006). Additionally, these studies are valuable for their focus on practical applications and real-world outcomes (Merriam, 2009), making them ideal for assessing the implementation and impact of new technologies.

Data Collection and Analysis

Context

This study was conducted at a large middle school in the southeastern United States. While the school does not stand out for its technological advancements, it represents a common scenario in public schools across similar regions. This context is essential as it allows the exploration of LGAI adoption in an environment where such innovations are not standard,

thereby providing insights into the challenges and possibilities of integrating new technologies. Importantly, all activities related to this case study took place outside student instructional time, utilizing teacher planning periods when this type of work is commonly done.

Participant

The primary criterion for participant selection was active engagement with LGAI technologies for lesson planning by a classroom teacher. This focus ensured that the study's findings would be directly relevant and informed by the experiences of a teacher implementing these technologies. This approach aligns with purposive sampling strategies recommended for qualitative research when a detailed, in-depth exploration of a particular phenomenon is required (Patton, 2015).

The participant was recruited through an existing professional relationship. The researcher made an initial contact via email, including a detailed invitation outlining the study's purpose, significance, and participation requirements. This step ensured transparency and informed consent (Merriam & Tisdell, 2015).

Thomas Miller (a pseudonym) is a white male eighth-grade science teacher with twenty-one years of classroom experience. He states that he is enthusiastic about integrating technological tools into his teaching practices. His approach to using LGAI for lesson planning provides a practical case study of the TPACK framework (Mishra & Koehler, 2006).

The researcher shared a consent form with Thomas via email, outlining the study's purpose, procedures, potential risks, and benefits. Thomas was informed about the nature of the study and his rights as a participant (AERA, 2011). The researcher offered to discuss the consent and study requirements and answer any questions. Thomas replied that he had no questions and provided consent. The researcher provided an overview of the data collection methods, including

lesson plan analysis, recordings of planning sessions, think-aloud activities, and a semi-structured interview.

Data Collection Procedures

This study utilized a multifaceted approach to data collection, purposefully selecting methods that would directly address the research questions. These methods were chosen to offer both process-oriented and reflective insights, providing a comprehensive understanding of the participant's engagement with LGAI.

Thomas was provided with recording instructions (see Appendix B for Directions for Tasks), and he documented his interaction with the technology during the lesson planning process. These recordings captured both the planning process and the content generated, allowing for detailed real-time observation of how LGAI was used (Merriam, 2009). This method provided concrete examples of how LGAI was applied during the planning stages.

In addition to the recordings, artifacts were gathered to examine the lesson plans produced with LGAI's aid. This method offered insights into LGAI's structural and content-related impacts by documenting how the technology influenced the design and outcomes of the educational materials (Merriam, 2009).

A week later, an in-person session was conducted, including a think-aloud protocol and a semi-structured interview (See Appendix A for Interview Questions). The think-aloud method was chosen because it allowed for real-time exploration of cognitive processes and decision-making criteria during LGAI usage (Ericsson & Simon, 1993). This method provides insights into the participant's perceptions and strategies while interacting with LGAI for lesson planning. Follow-up questions were used to explore the participant's reasoning and elaborate on the emerging patterns in the data.

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Finally, a semi-structured interview was conducted to gather reflective insights on the overall impact of AI-assisted planning. This interview allowed for exploring the participant's experiences and provided flexibility to probe more deeply into aspects directly related to both research questions (Rubin & Rubin, 2005).

This combination of methods ensured that the study captured not only how LGAI was used but also how it affected educational products, making it possible to generate meaningful conclusions about the integration of LGAI in planning practices.

Data Analysis Procedure

This study draws on the AI-TPACK framework to analyze how technological, pedagogical, and content knowledge intersect when LGAI is integrated into instructional planning. Using this framework as a guiding lens, the study examines the role of LGAI in enhancing planning practices and how these technologies align with the pedagogical goals and content knowledge of the participating teacher.

Upon collecting data from lesson planning artifacts, screen recordings of planning sessions, think-aloud protocols, and semi-structured interviews, the data were prepared for detailed thematic analysis. This comprehensive dataset offered a robust foundation for examining how LGAI is integrated into educational planning and understanding its broader impacts within classroom settings.

Following the data analysis guidelines established by Braun and Clarke (2006), the process began with thoroughly reading all collected materials to ensure familiarity with the content. The researcher compiled a description of teacher actions and decisions from the screen recordings. This immersion phase helped identify preliminary concepts and patterns, which were further explored through coding.

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The inductive coding process was initiated by thoroughly reviewing the transcripts, screen recordings, and lesson artifacts. During this review, key concepts, patterns, and ideas relevant to the research questions were identified and annotated. These annotations were then grouped into initial codes based on commonalities or recurring elements related to using LGAI in lesson planning. As coding progressed, these codes were refined through iterative analysis, allowing for the emergence of broader themes (Braun & Clarke, 2006). This approach ensured that the coding was grounded in the data without being constrained by pre-existing frameworks or assumptions (See Appendix C Theme, Sample Codes, and Sample Data).

Analysis of Specific Data Points

The analysis of specific data points focused on distinct aspects of the participant's interaction with LGAI in educational planning. Each data type was treated independently to ensure the analysis captured nuanced insights related to the use of LGAI in lesson planning. Using multiple data sources enhances the credibility and trustworthiness of the analysis, a key consideration in qualitative research (Lincoln & Guba, 1985).

The lesson planning artifacts provided concrete evidence of the teacher's integration of LGAI in creating and refining lesson materials. Artifacts are a widely accepted form of data in educational research, offering tangible insights into practice (Merriam, 2009). These artifacts were analyzed to assess the impact of AI-generated content on the lesson plans' structure, quality, and content. Specific attention was paid to how LGAI suggestions were adopted or modified and the extent to which they aligned with pedagogical goals. The combination of artifacts with other data sources, such as interviews and think-aloud, offers a fuller picture of the influence of LGAI on instructional strategies (Patton, 2015).

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Screen recordings of the teacher's engagement with LGAI during lesson planning were reviewed to capture real-time interactions between the teacher and the AI tool. Observational data, where actions are captured as they unfold, can reveal implicit decision-making processes (Creswell & Creswell, 2018). The recordings helped identify the teacher's decision-making processes, including the points at which he accepted, rejected, or adapted LGAI suggestions. This data source was particularly useful for understanding the practical workflow of integrating AI into lesson planning and how it affected the teacher's cognitive and pedagogical approaches. Observational methods, particularly in real-time contexts, provide insights that may not be accessible through interviews or reflections alone (Stake, 1995).

The think-aloud protocols were analyzed to gain insights into the teacher's reflective and cognitive processes using LGAI. Think-aloud protocols are widely recognized as a valuable method for capturing cognitive processes and have been successfully used in educational research to explore decision-making (Ericsson & Simon, 1993). The verbalizations provided during the session were transcribed and coded to capture key thoughts, decision-making moments, and justifications for the choices made during the planning process. This method complements the artifacts and recordings, offering an in-depth understanding of the teacher's perceptions of LGAI, including how the tool was used to address instructional challenges and tailor lesson content to meet student needs (Rubin & Rubin, 2005).

The semi-structured interview was analyzed to capture reflective insights into the participant's overall experiences with LGAI. Semi-structured interviews are often used in qualitative research to explore participants' deeper reflections and attitudes (Merriam, 2009). This form of data collection allows for flexibility in exploring the participant's perceptions while providing enough structure to maintain focus on the research questions. The interview data

provided a deeper understanding of the teacher's attitudes towards AI-assisted lesson planning, including the perceived benefits and challenges. This analysis also explored how the teacher viewed the long-term impact of LGAI on educational practices and how these insights aligned with the initial research questions (Rubin & Rubin, 2005).

Each of these specific data points was cross-referenced to ensure consistency and to provide a comprehensive view of LGAI's role in educational activity planning. Triangulation of multiple data sources enhances the validity of the findings, reducing the potential for bias and providing a more nuanced exploration of LGAI's impact on teaching and learning (Patton, 2015; Lincoln & Guba, 1985).

Qualitative Quality, Ethics, and Positionality

To ensure the trustworthiness of the qualitative data, several strategies were implemented to enhance credibility, transferability, dependability, and confirmability (Lincoln & Guba, 1985). Credibility was established through prolonged engagement with the data and the participant, allowing an in-depth understanding of the study's context and insights. Member checking, which occurred as the researcher drafted initial findings, further bolster credibility (Creswell & Poth, 2018). To promote transferability, detailed descriptions of the research context, selection process, and participant characteristics are provided, enabling others to assess the relevance and applicability of the findings in different settings (Merriam & Tisdell, 2016). This approach aligns with qualitative research standards, ensuring the study's findings are robust and can be interpreted or applied in other educational environments (Shenton, 2004).

Ethics

Ethical integrity was paramount throughout the research process; therefore, the researcher's institution's established IRB protocol was strictly followed. This included fully

informing the participant about the study's nature and potential risks and benefits through a comprehensive consent process (AERA, 2011). Confidentiality was maintained by anonymizing participant data and securely storing all research materials. Additionally, measures were taken to prevent the collection or use of sensitive or personally identifiable information from students.

Positionality

This research is informed by a pragmatist stance and a critical theory framework, reflecting the researcher's career-long endeavor to bridge the gap between a theoretical critique of educational inequities and the pragmatic application of teaching solutions. Understanding the heavily contextual nature of educational effectiveness (Labaree, 2010) motivates this study to pursue adaptable and broadly applicable strategies across educational settings. In part, this research aims to uncover how LGAI can serve as a tool for equity, facilitating effective teaching strategies regardless of the educator's background or teaching style. By focusing on LGAI's potential to support high-quality educational practices, this study aligns with broader goals of supporting systemic reforms and addressing immediate classroom needs.

Findings

This section presents the findings from the case study of Thomas Miller, an 8th-grade science teacher, and his use of LGAI in planning. The findings are organized into three primary areas: 1) Teacher Engagement Strategies, 2) Impact on Lesson Structure and Content, and 3) Overall Teacher Experiences.

Teacher Engagement Strategies

This section outlines Thomas Miller's engagement strategies for interacting with LGAI to plan his evolution unit. The strategies include providing context, engaging in dialogue, and strategically selecting LGAI-generated content.

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Thomas initiated the AI interaction by establishing a detailed contextual framework (Mishra et al., 2023). He prompted the LGAI to simulate the role of an "expert 8th-grade science teacher" to provide grade level and subject area context and to establish the expected depth of content and instructional strategy. He input his state's precise science standards to refine the LGAI's outputs. This step directed the LGAI to generate relevant and practical suggestions aligned with the current unit's focus. In response to the LGAI's initial fourteen-week unit pacing, Thomas provided additional contextual adjustments to conform to the school's four-week timeline. These actions tailored LGAI capabilities to meet specific educational timelines and objectives.

Thomas engaged in an interactive dialogue with the LGAI. He probed the LGAI's recommendations through specific questions to refine its outputs and gain deeper insights. For instance, he questioned the LGAI's pacing suggestion, asking, "Why do you recommend this pacing?" After considering LGAI's response, Thomas added subtopics from the LGAI's generated list to his planning document. He also engaged in back-and-forth dialogue, asking questions like, "How important is the students' understanding of relative vs. absolute dating?" (Relative dating involves determining the age of an object or event in relation to other objects or events, while absolute dating assigns a specific numerical age using methods like carbon dating.) Upon receiving the LGAI's response, Thomas integrated this concept into his lesson structure, sharing in the interview that "as a result of the conversation with the chatbot and my experience, I decided that I could sort of simplify it a little bit, but make it into a one-day discussion of the differences." The interactive dialogue between Thomas and the LGAI helped refine the AI's outputs and gave Thomas a better understanding of the reasoning behind the AI's suggestions. He noted, "The biggest thing I've learned is that the first prompt is just the first prompt; it's a

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conversation." These examples demonstrate Thomas's active role in dialoguing with the AI, ensuring that the technology served as a responsive educational tool rather than a directive one.

Thomas demonstrated a strategic approach where he either adopted, adapted, or outright rejected the LGAI's recommendations based on their practical applicability and educational value. For instance, he adopted the LGAI's idea of a vocabulary notebook. Thomas implemented this idea to improve student interaction with key terms, an approach he described as a "continuous learning tool." He modified a lab activity recommended by the LGAI to include a jigsaw strategy, a cooperative learning activity where students become "experts" on different aspects of a topic and then teach their peers about the types of fossils. This adaptation not only fit within the classroom's time constraints but also encouraged peer-to-peer learning and engagement. Reflecting on this adaptation, Thomas noted, "It allows every student to become an expert in one part of the curriculum, which they then share with their peers, enhancing their understanding through teaching." Thomas did not deem all suggestions fit; some were rejected when they did not align with the unit's goals or practical classroom realities. Reflecting on his engagement with the LGAI, Thomas commented, "The AI often suggests a wide range of ideas, but it is my role to filter these to find what's most applicable and beneficial for my students." This strategic use of LGAI reflects the integration of AI in enhancing pedagogical outcomes through tailored interactions and content adaptation (Cooper, 2023; Mishra et al., 2023).

This practice of selective adoption highlights the adaptability of LGAI. It reflects Thomas's informed decision-making in effectively blending technology with traditional teaching methods, drawing on his teaching experience. Such engagements enrich his understanding of leveraging technological tools for educational advancement (Küchemann et al., 2023), ultimately

shaping a more dynamic and responsive teaching strategy that reflects both the possibilities and limitations of LGAI.

Impact on Lesson Structure and Content

The integration of generative LGAI into Thomas's science lesson planning process demonstrated algorithm-driven influences. These influences manifest in several distinct areas: scope and sequence, content focus, and inclusion of LGAI-generated materials.

Initially, the LGAI proposed an expansive scope and sequence with a comprehensive 14-week curriculum for the evolution unit, far exceeding Thomas's time for this unit. Although Thomas adjusted this to a four-week timeline, the initial proposal by LGAI shaped his approach to the scope and sequence of topics. He reflected on this interaction, noting, "The AI gave me a broad overview, which was more than I needed, but it forced me to think big at first and then scale down," illustrating how the LGAI's suggestions framed his planning process.

LGAI proposed specific content focuses (Jauhiainen & Guerra, 2023; Kooli, 2023), impacting what Thomas included in his lesson. In his dialogue with LGAI, Thomas asked about the importance of teaching relative vs. absolute dating. The AI provided a detailed rationale, which influenced Thomas's teaching emphasis. Thomas noted, "The AI's explanation about relative vs. absolute dating really clarified its importance, which pushed me to integrate it more deliberately into my lessons." This interaction underscores how LGAI impacted the content Thomas included in his lesson.

Responding to specific inquiries from Thomas, LGAI generated novel educational materials that influenced the instructional activities in his classroom. While these materials were produced due to direct prompts from Thomas, the content provided by LGAI was uniquely crafted by its algorithms, demonstrating the tool's capacity to create original resources (Adams et

al., 2023; Chaudhry et al., 2023). The AI suggested specific activities for vocabulary instruction, one of which Thomas implemented. LGAI generated specific lab ideas, such as squashing bread between two books to demonstrate a carbon film fossil, which Thomas noted were novel to him and he included in his lessons. When developing assessments, LGAI suggested multiple assessment options, which Thomas used as warm-ups and exit tickets in class. These examples illustrate how LGAI's responses, built on its training data and algorithms, impact curriculum content.

The utilization of LGAI shaped the lesson structure and content in Thomas's classroom. By adjusting lesson plans and integrating content based on LGAI's capabilities, Thomas demonstrated adaptability to meet educational objectives. These structural adjustments directly correlate with personal impacts on educators themselves, particularly in how they perceive and utilize LGAI in their professional practices.

Overall Teacher Experiences

Engaging with LGAI when planning impacts lesson structure and content; however, the data collected in this case study indicates that engaging with LGAI also impacts its users (Mishra et al., 2023). Thomas reflected on how working with LGAI impacted his confidence, decision-making abilities, and strategic use of technology.

Thomas found value in the instant feedback and diverse ideas generated by LGAI. He elaborates on its role in enhancing his teaching: "It's like sitting down and talking to somebody who is an expert science teacher already and asking for their advice. I wouldn't necessarily follow every piece of advice they give me, but hearing them give a suggestion makes me think about why I do things the way I do and whether they're based on habit or based on any kind of evidence or experience." This LGAI aspect, much like Mishra's drunk, smart intern, helped

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Thomas critically evaluate and improve his teaching methods. Additionally, Thomas valued the assurance that engaging with LGAI brings to his lesson planning. He described the benefit of this interaction, saying, "If the AI suggests something and I'm already doing it, it's like getting a vote of approval. It's reassuring, and it helps me feel more confident about the decisions I make." Thomas's commentary shows how LGAI served as a tool for generating ideas (e.g., Liang et al., 2023; Zhu et al., 2023) and as a means to validate professional judgment.

In the interview, Thomas highlighted the ability of LGAI to support responsive planning to make real-time classroom adjustments. He emphasized the importance of flexibility, stating, "Being able to adjust plans on the fly is crucial." He described a scenario where, "If my first-period lesson bombs, I have a planning period right after that; sometimes I'll come back and ask an AI Chatbot to generate a version of that activity that–I might say I need this to be simpler, or I need this to finish more quickly." This capability allowed immediate pedagogical responses that enhanced the learning experience without losing instructional time. Thomas felt that such dynamic adjustments allowed him to maintain high educational standards, adapting swiftly to ensure that teaching methods aligned with the specific learning challenges or time constraints that arose during each class.

Thomas's confidence and strategic decisions were supported by the LGAI affordances he outlined. He acknowledged the efficiency of LGAI, noting, "AI is not doing anything that I couldn't do. It's just doing it a whole lot faster." This speed allowed him to use LGAI to generate diverse assessment questions and answer keys rapidly, enhancing his ability to cater to diverse student needs. He appreciated that LGAI can "spit out questions that are great as a starting point very, very quickly" and create multiple versions of texts or tests.

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Thomas also discussed the challenges teachers might face when integrating technology like LGAI without guidance (Celik, 2023; Ning et al., 2023). He advocated for a supportive approach where more experienced educators assist novice teachers in navigating the complexities of AI tools: "It's more important for novice teachers to … be collaborating with another teacher as well because you don't necessarily know from experience which kinds of suggestions from AI are going to work and which ones won't." Thomas recognized that LGAI's outputs can lack contextual understanding (Cooper, 2023; van den Berg & du Plessis, 2023) and must be evaluated for quality and relevance (e.g., Kooli, 2023; Sallam et al., 2023). His insights highlight the importance of mentorship and collaboration in effectively leveraging AI in education.

Thomas's interaction with LGAI influenced his pedagogical approach, reinforcing his professional autonomy and enhancing his instructional strategies. By critically assessing and selectively adopting AI-generated suggestions, he refined his educational practices and ensured that his teaching remained responsive and student-centered. His experiences reflect a thoughtful integration of technology, which bolstered his confidence and enriched the educational environment for his students.

Discussion

Thomas's integration of LGAI into his instructional planning and content creation processes exemplifies the role of such technologies in enhancing educational practices. By utilizing LGAI, Thomas personalized learning experiences for his students and aligned educational content with student needs. This direct contribution to personalized learning is supported by findings highlighting LGAI's capacity to adapt educational materials to diverse

student profiles, thereby improving engagement and comprehension (Adams et al., 2023; Zhu et al., 2023).

Thomas's use of LGAI also increased his efficiency. By automating and optimizing the creation and adaptation of instructional materials, LGAI allows educators like Thomas to reallocate their time and resources toward more critical pedagogical activities, such as direct student engagement and assessment. This improvement in operational efficiency resonates with observations by Cooper (2023) and Ross (2023), who noted that LGAI could streamline workflow and reduce the administrative burden on educators, enabling a more responsive teaching environment.

The true potential of these technologies, however, lies in their ability to engage with educators as a responsive collaborator, inviting a deeper, more nuanced interaction that can mirror human dialogues, thus enhancing the learning process through new forms of knowledge synthesis and creative expression (Mishra et al., 2023). As Thomas articulated, specific practices can greatly enhance LGAI's effectiveness. However, due to the limited scope of this single case study, further research is necessary to confirm and expand upon these initial results:

1. Providing Detailed Contextual Information: Educators providing detailed contextual information will optimize LGAI's outputs to fit specific teaching environments (Mishra et al., 2023).
2. Clarifying and Focusing Inquiries: By posing clear and specific prompts, educators can guide LGAI in producing precise, relevant outcomes, enhancing the usefulness of generated results. A dialogue between the user and the LGAI enables real-time adjustments and ensures outputs are directly aligned with user needs.

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3. Selectively Adopting Suggestions: LGAI suggestions must be selectively adopted; educators should integrate them only when they align with established pedagogical goals and the specific needs of their students.
4. Engaging in Collaboration: Collaboration is key; working with professional learning communities or mentor teachers to review and adapt LGAI-generated resources ensures these are pedagogically sound and practically applicable.
5. Implementing Proactive and Reactive Strategies: Effective LGAI use involves proactive and reactive strategies. Proactively, educators can use LGAI to plan and prepare lessons and curriculum. Reactively, it serves as a dynamic tool to quickly adapt to changing classroom scenarios, addressing educational challenges as they arise.

This case study highlights the crucial role of human guidance in utilizing LGAI effectively. It reinforces that LGAI's ability to provide tailored educational materials and scaffolding (e.g., Adams et al., 2023; Zhu et al., 2023) is contingent upon human input. When paired with educators who can provide and refine specific inputs, LGAI can be viewed as an “expert collaborator” (Mishra et al., 2023, p. 8), not in the traditional sense of human expertise, but as a competent assistant. LGAI can support educators by performing a range of complex tasks.

As explored through Thomas's case, the integration of LGAI into educational settings offers a unique perspective on the potential of LGAI technologies within K-12 education. This discussion now seeks to bridge the insights from Thomas's practical applications of LGAI with the conceptual understandings from the literature review and the TPACK framework, particularly its adaptation to include AI technologies and context-specific understandings.

LGAI as a Pedagogical Tool: Aligning with TPACK

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Thomas's use of LGAI for planning illustrates a sophisticated integration of technological, pedagogical, and content knowledge, the heart of the TPACK framework (Mishra & Koehler, 2006). His methodical interactions with LGAI—from providing context to strategic questioning to adapting suggestions—demonstrate technological fluency and pedagogical and content knowledge. This aligns with TPACK's emphasis on the dynamic interplay of these components for effective technology integration in teaching.

Thomas's approach extends beyond the traditional TPACK framework to adopt a Context-Aware AI-TPACK model, which integrates knowledge of students, the school environment, and specific educational goals into AI tool usage. This model emphasizes that AI integration succeeds not only through technological or pedagogical expertise but also by understanding the specific contexts in which it is applied. Thomas's reflective practice and collaboration with his professional learning community highlight the need for this expanded framework, which includes AI-specific strategies and ethical considerations (Celik, 2023; Ning et al., 2024). His deep understanding of both his students and the school environment underscores the importance of considering broader contextual factors when using AI to improve instructional planning.

Limitations

This study has several limitations, including its case study design, which restricts the ability to generalize findings. The study does not explore the biases and inaccuracies inherent in LGAI outputs or the ethical considerations concerning student data privacy and LGAI transparency. The lack of discussion on the challenges of change management and the need for professional development in adopting new technologies also restricts the study's applicability to broader educational settings. These limitations suggest a need for more comprehensive research

to understand the complexities and ensure the responsible use of LGAI technologies in education.

Implications and Future Research

The insights from Thomas's use of LGAI in educational planning suggest several implications for future practices. This research can serve as a foundation for identifying best practices in LGAI usage, which could be used to create targeted professional development programs for teachers. Such programs would equip educators with the skills and knowledge to effectively integrate LGAI tools into their planning practices.

As LGAI technologies evolve, ongoing research is necessary to explore their long-term impacts on education and integration into diverse educational settings. Future research should broaden the scope by including multiple case studies across various educational environments to capture a wider range of experiences and outcomes. Incorporating quantitative methods could enhance the understanding of the impacts of LGAI on teaching practices and student learning outcomes, providing a more comprehensive assessment of its educational value. Exploring the longitudinal effects of LGAI integration could also offer deeper insights into how these technologies influence long-term educational strategies and student performance.

Conclusion

The case study of Thomas, when viewed through the lens of the Context-Aware AI-TPACK framework, not only supports the theoretical benefits of LGAI but also brings to light the practical complexities and the nuanced role of educators in leveraging these technologies. By effectively integrating LGAI, educators like Thomas are impacting their pedagogical practices and contributing to a broader understanding of how such technologies can be harnessed to advance educational goals. This discussion has highlighted both the potential and the necessary

cautions of integrating LGAI into educational settings, providing a balanced view that will guide future implementations and research in educational technology.

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Appendix A

Interview Questions

1. Can you describe how you initially started using generative AI in your lesson planning process?
2. In what specific ways do you use generative AI to plan educational activities, especially those aimed at developing or supporting reading comprehension?
3. What are your perceptions of generative AI as a planning tool? Do you see it more as a collaborator, a tool, or a guide in your planning process?
4. How do you decide which suggestions from generative AI to incorporate into your lesson plans? Are there criteria you use to evaluate its recommendations?
5. How has the integration of generative AI into your lesson planning changed the way you structure your lessons?
6. Can you provide examples of how content in your lessons has been influenced or modified by suggestions from generative AI?
7. From your experience, how has the use of generative AI in lesson planning impacted student engagement and comprehension in reading-related activities?
8. Have you noticed any changes in your teaching efficiency or effectiveness since incorporating generative AI into your planning process?
9. How does generative AI assist you in tailoring your lessons to meet the needs of a diverse student population?
10. Can you share a specific instance where generative AI helped you address a particular challenge related to student diversity in your classroom?

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11. Reflecting on your experiences, what are the most significant benefits and challenges of using generative AI for lesson planning?
12. How do you envision the role of generative AI in educational planning evolving in the future? Are there ways it could be improved to better serve your needs as a teacher?

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Appendix B

Directions for Tasks

Screen Recording Instructions:

1. Please screen-record the entire process during your lesson planning sessions when you interact with the generative AI tool.
2. Make sure to capture both your prompts/queries to the AI and the AI's responses/suggestions.
3. If you incorporate any of the AI's suggestions into your lesson plans, please ensure the screen recording tool captures that work.
4. Save these recording files to share with me for analysis.

Think-aloud Instructions:

1. Please share the resource(s) you created during your planning session.
2. Explain how you used generative AI in your planning process, including the decisions you made to accept, reject, or revise generative AI suggestions.

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Appendix C

Theme, Sample Codes, and Sample Data

Theme	Sample Codes	Sample Data
Teacher Engagement Strategies	Providing context, Interactive dialogue, Strategic selection	"Why do you recommend this pacing?" "How important is the students' understanding of relative vs. absolute dating?"
Impact on Lesson Structure and Content	Pacing adjustment, Content focus, Inclusion of LGAI-generated materials	"The AI gave me a broad overview, which was more than I needed, but it forced me to think big at first and then scale down." "If my first-period lesson bombs, I can ask an AI to adjust it quickly."
Overall, Teacher Experiences	Confidence in decision-making, Strategic use of technology, Pedagogical autonomy	"It's like sitting down and talking to somebody who is an expert science teacher." "AI is not doing anything I couldn't do; it's just doing it a whole lot faster."