Reimagining English Learning: Technology in Material Design for Secondary Education

Yanshen Yu[1], Xuefang Huang[2], Peijun Li[3], Qingzu Lin[4], Jintian Tang[5]

[1,3,4,5]School of Foreign Studies, Lingnan Normal University, Zhanjiang 524048, Guangdong, China

[2]English Department, Zhanjiang Cunjin Peicai School, Zhanjiang 524048, Guangdong, China

[1]yufirefish@163.com, [2]bianca840809@163.com, [3]3398785598@qq.com, [4]2793706976@qq.com, [5]2358488109@qq.com

Abstract: *As classrooms move towards a digital landscape, a key factor for successful English language education is to create and apply new experience in teaching materials. This study investigates the impact of technology integration on English teaching material design in secondary education, unveiling the significant role of teachers' pedagogical expertise. Qualitative data, derived from semi-structured interviews, field notes, and teaching documents, were collected and analyzed, revealing that technology, when guided by pedagogical principles like Activity Theory, TBLT, Constructivism and Cognitive Load Theory, can enhance student engagement and language learning. The findings also suggest teachers' evolving roles, from instructors to facilitators and tech integrators, significantly transform the classroom dynamics. The study highlights the need for robust supporting systems, including professional development and infrastructure, which can ensure effective tech integration. It concludes that with the right support and pedagogical understanding, technology can navigate English education into a more dynamic and student-centered experience.*

Keywords: English learning, Material design, Technology, Secondary education, Pedagogy.

1. Introduction

In recent years, the integration of technology into educational materials has fundamentally reshaped teaching methodologies across various subjects, particularly in English language education for secondary students. As classrooms move towards a digital landscape, the design and use of technology-enhanced materials in English teaching have become focal points for educators, policymakers, and researchers. English proficiency is widely acknowledged as a critical skill in the globalized world, enabling individuals to participate effectively in international communication, academia, and the workforce. Therefore, equipping secondary students with necessary English language skills is essential, and technology-enhanced materials offer promising avenues for supporting this goal by making learning more engaging, interactive, and accessible [1] [2]. The global trend towards digital literacy has fueled the need to integrate technology meaningfully within the secondary education curriculum. For English teaching, specifically, this involves using technology to create dynamic, contextually relevant materials that cater to diverse learning styles and demands. Traditional English teaching materials, such as textbooks and printed worksheets, often lack the flexibility to adapt to individual students' learning paces or accommodate a variety of cultural and linguistic backgrounds. Technology, however, can overcome these limitations by offering adaptive and personalized learning experiences. Interactive language apps, multimedia presentations, online games, digital storytelling tools, streaming platforms and even AI are just a few examples of technology-enhanced resources that can enrich the English language learning process. These tools can provide students with immersive language experiences that traditional methods may not offer, making abstract concepts more tangible and fostering greater engagement [3].

Despite the apparent benefits, the use of technology in material design for English teaching also poses significant challenges. Research indicates that while digital resources can increase engagement, they may also contribute to cognitive overload if not carefully designed. Furthermore, teachers require adequate training to use these resources effectively and integrate them seamlessly into their curricula. Many teachers, particularly in low-resource settings, may lack the digital literacy skills or the access to technology required to fully leverage these materials [4]. Additionally, concerns regarding pressure to cover the prescribed curriculum content and prepare students for examinations persist, as teachers with tighter curriculum requirement may be limited in the flexibility to make creative use of technology. These challenges lay stress on the importance of designing technology-enhanced materials that are user-friendly, context-sensitive, and accessible to all learners [5].

The objective of this study is to investigate how technology can be optimally integrated into material design for English language teaching in secondary education. Specifically, the study aims to explore the types of technological tools and resources that are most effective in enhancing language learning, engagement, and interaction among secondary students. It also seeks to identify the conditions under which these materials yield the best results, considering factors such as cultural relevance, accessibility, and cognitive load. Additionally, the study will assess the role of teachers in facilitating technology-enhanced English learning and investigate the training and support systems needed to help educators effectively implement these resources.

The significance of this research lies in its potential to contribute to a more inclusive, effective, and sustainable approach to English teaching in secondary education. By examining the design principles and pedagogical strategies that make technology-enhanced materials successful, this study can provide insights into how educational technology can support diverse learning needs and overcome some of the limitations of traditional language instruction. For that purpose, the study is geared towards the following research questions:

1) How has technology been implemented in the actual

material design and use in secondary English teaching?

2) What are the challenges that teachers face in implementing technology-enhanced materials for English teaching in secondary education, and what support systems are necessary to address these challenges?

2. Literature Review

2.1 Language Teaching Materials in Use

As globalization evolves and the demand for foreign language education increases, the development and use of foreign language textbooks have garnered significant attention. These materials are not only essential for conveying linguistic knowledge but also play a vital role in cultural education and shaping learners' worldviews, values, and philosophies [6]. The integration of technology into language teaching has revolutionized the structure and delivery of textbooks, broadening their scope from traditional printed content to dynamic, multimodal resources [7]. This evolution calls for teachers to adapt and supplement textbook content to align with diverse teaching and learning contexts. Existing empirical research on English textbook use primarily revolves around three themes: interactive dimension of teaching materials, textbook use strategies, and factors influencing the use of textbooks.

Research on foreign language textbooks has shifted from a singular focus on teacher use and content evaluation to a broader exploration of knowledge representation and learner interaction. Studies now recognize learners as active participants in using textbooks, investigating their behaviors, emotional responses, and influencing factors [8]. Such insights have significant implications for optimizing classroom outcomes, refining textbook content, and guiding textbook authorship.

More notably, research on strategies for using English textbooks is one of the key themes. Teachers frequently adopt approaches such as skipping, adding, modifying, or reordering textbook content. These strategies operate on two levels: macro-level strategies and micro-level strategies. Macro-level strategies include curriculum adaptation, development, supplementation, planning, experimentation, and material evaluation. Micro-level strategies encompass incorporating diverse resources, flexibly rearranging lesson sequences, and supplementing or skipping tasks, units, or themes [9].

The factors influencing teachers' textbook use behaviors can be broadly divided into macro, meso, and micro-level influences [10] [11]. At the macro-level, curriculum standards and examination systems would fundamentally determine the teachers' autonomy in material selection and teaching activities. This is particularly evident in less economically developed regions where teachers adhere closely to national curriculum requirements. At the meso-and micro level, students needs and teaching resources would dictate teachers' motivation and initiate to use material creatively. Particularly, access to diverse resources positively influences teachers' ability to innovate and refine their textbook use. On top of that, students' classroom performance and immediate feedback

significantly influence teachers' material use. For example, when students' cognitive levels exceed textbook content, teachers tend to expand upon texts or develop supplementary materials.

The evolving landscape of foreign language textbooks reflects broader shifts in education, driven by globalization, technological innovation, and changing learner needs. While significant strides have been made in understanding and improving teaching material design and use, persistent gaps call for continued exploration. By addressing these challenges, future research can ensure that textbooks remain effective, equitable, and responsive tools in foreign language education, fostering richer learning experiences for diverse populations.

2.2 Technology in Language Teaching Materials

Currently, technology has played an increasingly pivotal role in the design of educational materials for English language teaching in secondary education. As classrooms shift toward digital and interactive learning, a growing body of literature has examined the effectiveness, challenges, and potential of various technologies in supporting English teaching.

Several foundational theories inform research on technology in material design for secondary English teaching. Constructivist learning theory underpins much of the work in this field, emphasizing active learning and the importance of social interaction in constructing knowledge. Technologies such as digital storytelling platforms, collaborative apps, and multimedia resources align with constructivist principles by enabling students to co-construct meaning, share insights, and engage actively with content. Cognitive load theory is also widely referenced, focusing on how technological tools can reduce cognitive overload by breaking down complex linguistic concepts into manageable, multimedia-enhanced segments. Additionally, multimodal learning theory guides research into combining visual, auditory, and textual elements to enrich understanding and improve retention, recognizing that learners process and retain information more effectively when exposed to diverse modes of presentation [12].

One of the most consistent findings across the literature is the positive impact of technology on student engagement. Tools like digital broadcast platforms, interactive language games, and hypermedia resources have been shown to increase students' interest and motivation in learning English [13]. A study by Türel and Johnson demonstrated that secondary students who were exposed to interactive whiteboards (IWBs) displayed greater enthusiasm and a more positive attitude toward English language learning compared to those who used traditional materials [14]. Similarly, interactive and immersive experiences such as language simulations were found to promote active participation by placing students in lifelike scenarios where they could practice language skills authentically [15].

With the increasing availability of digital resources, researchers have observed a shift toward developing multimodal literacy—the ability to interpret and create meaning across multiple media forms. This skill is becoming essential as students encounter information in diverse formats. Studies by Mishan highlight how integrating multimedia (e.g.,

videos, images, audio) into English teaching materials can support vocabulary acquisition, pronunciation, and comprehension. Such resources allow students to engage with the language in ways that go beyond text, thus promoting a deeper and more flexible understanding of English. These multimodal approaches cater to varied learning styles, making English more accessible and relevant to different learners [16].

Technological advancements also support differentiated instruction and autonomous learning. Digital platforms often include adaptive features that allow materials to be tailored to individual skill levels, enabling students to progress at their own pace. In the same token, Generative AI (GenAI) stands out as a transformative tool in the realm of curriculum development in education. Its ability to introduce a dynamic and adaptive dimension to the creation and delivery of educational content makes it invaluable. For instance, educators can leverage GenAI to craft vivid examples, develop captivating learning materials, or design assessments that are closely aligned with the targeted learning goals. Such personalized feedback can significantly enhance learners' confidence and engagement, particularly for students who may struggle with traditional classroom-based English instruction [17] [18].

Despite promising findings, several gaps remain in the literature. While many studies report immediate improvements in motivation and engagement, there is limited situation-specific research on the sustained impact of technology-enhanced materials on language proficiency and retention. In addition, emerging tools such as artificial intelligence, augmented reality, and virtual reality are still relatively new in ELT. Research on how these technologies can be best utilized in secondary English classrooms is in its infancy, and there is considerable potential to explore their applications in areas like language practice, pronunciation, and immersive cultural experiences.

3. Research Methodology

3.1 Research Context and Participants

In Guangdong, China, secondary English education is undergoing transformation since technology increasingly shapes teaching practices and material design. As a province at the forefront of economic and technological development, Guangdong faces unique challenges and opportunities in integrating digital tools into English learning. Traditional teaching materials often fall short in addressing the diverse linguistic needs and digital literacy of students in this dynamic region.

At the time of the study, where convenient sampling was used, eight English teachers from Guangdong secondary schools agreed to share their ideas and practices of their technology integration in teaching materials and provided informed consent to have their data used for research purposes. Among the eight participants, six have got a bachelor's degree and two have master's degree as teachers of English as a foreign language. To protect the confidentiality of the participants, the teachers are numbered from T1 to T8. The participants' background information is provided in Table 1. Ethical

approval was obtained from the university and the school and research consents were obtained from the participants before the study conducted.

Table 1: Biographic information of the participants

Partici-pant	Gen-der	Deg-ree	Teaching experience (years)	Grade (at the time of the study)	School type
T1	F	BA	1	7	State, urban
T2	F	MA	20	12	State, urban
T3	F	BA	10	9	State, urban
T4	M	BA	4	8	State, rural
T5	F	MA	2	10	State, urban
T6	F	BA	3	7	Private, urban
T7	F	BA	7	8	State, rural
T8	F	BA	16	12	State, urban

3.2 Data Collection

Qualitative data were collected from multiple sources: semi-structured interviews, field notes, and teaching documents. The teaching documents comprised lesson plans and their corresponding presentation slides from each participant.

Semi-structured interviews were conducted with the eight participants, lasting about 40 minutes each, where they were asked about the questions concerning their perception of their technology application in their teaching material design on the day-to-day basis. The interview focused on 1) the teachers' pedagogy underlying their tech-based material design; 2) specific cases where they integrated tech into material design; 3) problems or challenges encountered in the design; 4) tech trainings or guidance the teachers have taken. As such, the interview data were the main sources for exploring the participants' tech-driven material design and triangulated with the data collected from filed observations, and documents. To avoid misunderstandings, the language used for the interviews was the native language of the participants: Mandarin. All the interviews were audio-recorded and conducted at places convenient to the participants, and then transcribed and translated by the third, fourth and fifth authors.

Fieldwork could be selective and clouded by the researchers' analytical perspective and positioning. Thus, although observations render part of the data, to nuance the findings and increase transparency by actively using participants' go-along comments, verified quotes jotted down during observations, teaching documents and interview data. Such data triangulation can be seen as strengthening trustworthiness of findings and conclusion. It also helps compare with the actual technology application in material designs which might relate to varied components and factors.

3.3 Data Analysis

Thematic analysis method was employed for qualitative data analysis. Initially, various forms of data were carefully sorted, coded, and categorized based on the research questions. Subsequently, the frequency of each code was counted to determine prominent themes. Thereafter, cross-data analysis was carried out. Consequently, themes emerged from the data without any predetermined theoretical suppositions. In essence, the data received an open-ended and comprehensive

treatment to enable the emergence of main features that optimally address the research questions. For ensuring reliability, the two authors independently analyzed the data first and then engaged in a discussion to ensure inter-coder agreement. Subsequently, we integrated our analysis and interpretation within the same procedure to generate a more detailed analysis. Thus, we executed an iterative process centered around our research questions to identify segments representing a priori constructs, themes, or ideas. Additionally, the participants were invited to read and provide comments on the first draft of data analysis since any interpretation of a learning scene will be more accurate and their comments were taken into consideration to refine the final analysis results.

All the codes were further reviewed, categorized, and integrated within and across different data sources, leading to three major themes of the tech-based teaching material design, including 1) teachers' pedagogy underlying tech use, 2) teachers' evolving roles in tech integration and 3) supporting systems.

4. Findings and Discussion

4.1 Teachers' Pedagogy Underlying Tech Use

The integration of technology into the design and use of English teaching materials is reshaping the educational landscape. However, technology alone cannot drive this transformation; it is the pedagogical knowledge of teachers that determines how effectively these tools and resources are utilized to enhance teaching and learning. Pedagogical knowledge, which encompasses an understanding of teaching methods, student needs, and curriculum goals, provides the foundation for teachers to incorporate technology seamlessly into their practice. Understanding technology in language education involves exploring fundamental theories and contextual frameworks to develop effective instructional materials.

Teachers' pedagogical knowledge is the cornerstone of effective technology integration into English teaching material design and use. It provides the foundation for selecting, designing, and using technology-enhanced materials in ways that align with educational goals and meet student needs. While challenges exist, they can be addressed through professional development, collaboration, and a focus on pedagogical principles. Although teachers would have their own preferred pedagogical theories in their teaching practices, the theoretical frameworks can generate a more desired learning outcome. As T6 stated in her interview: "As the national syllabus advocates Activity Theory in English teaching, I created a project using digital storytelling tools like Jianyin. The project required students to narrate personal experiences related to travel. I designed the project as a collaborative activity that involves students researching, scripting, and creating multimedia presentations. The video editing tool (Jianyin) acts as the mediating artifact, enabling students to construct knowledge while interacting with peers and real-world contexts. We all had fun in this project." Activity Theory can shed light on the iterative refinement of the teaching process. The teacher evaluates the outcomes—whether students effectively use the digital tool to express ideas, collaborate, and meet linguistic objectives—and modifies the activity accordingly. This dynamic adaptation reflects the theory's emphasis on evolving learning environments through constant feedback loops. By using Activity Theory, tech integration becomes more than a superficial addition of tools; it evolves into a means to foster deeper engagement, contextual relevance, and collaborative learning in English language education.

Likewise, T3 shared the teaching pedagogy underpinning her tech-enhanced material design: "I tend to adopt Task-Based Language Teaching in my routine teaching, because this approach focuses on meaningful use of language through real-world tasks. I would evaluate the activities in the textbook. If they are not purposeful, engaging, and aligned with communicative goals, I would resort to some online resources to re-design the tasks." Additionally, during the lesson, technology supports the task cycle: pre-task preparation (students watch videos and brainstorm vocabulary), the task execution (playing and interacting in English within the game), and post-task reflection (group discussions analyzing language use). The teacher scaffolds the learning experience, embedding prompts and feedback to ensure linguistic objectives are met. By focusing on language as a tool for achieving tangible outcomes, this approach demonstrates the seamless blending of pedagogy and technology.

Constructivism places significant emphasis on the active engagement of learners as they construct their understanding of knowledge. The social process of learning is characterized by collaboration and interaction. Language-teaching materials propelled by AI have the potential to foster collaborative and interactive learning environments. The constructivist approach is compatible with chatbots, virtual language exchange platforms, and AI-driven discussion forums, enabling students to participate in language learning actively. Within the constructivist paradigm, learners are perceived as engaged contributors who construct knowledge utilizing practical experiences and interpersonal engagements. Influenced by constructivism, T5 expressed her embrace of AI in her teaching: "To help students practice spoken English, I introduce AI chatbot Doubao that simulates conversations in real-life scenarios. Students can practice using the chatbots outside of class, improving their confidence in spoken English. I also assign specific chatbot conversation topics relevant to the lesson and track students' progress in class time. This tool allows students to practice in a low-pressure environment, and facilitate the students learning greatly."

The concept of Cognitive Load Theory was mentioned by T8 and she is well aware of the fact that the design of instructional materials should regulate cognitive burden to maximize learning outcomes efficiently. She shared her application of AI by saying that: "To accommodate varying reading levels, I used a large language model named KIMI, which can generate reading tasks related to articles in multiple difficulty levels. For each unit, I can assign each student a version of the reading tasks suited to their reading level. This allowed students to explore topics with tasks that suit their proficiency, reducing frustration and promoting comprehension. In class, students discuss the same topic but perform tailored tasks, fostering group engagement without highlighting their own weaknesses in reading skills. I also can

utilize this platform analytics to identify reading patterns and tailor future reading selections based on student needs." This balanced approach aligns with cognitive load theory by structuring technology-assisted lessons that manage cognitive demands effectively, fostering reading skills through meaningful and focused engagement.

As education continues to evolve in response to technological advancements, the role of teachers' pedagogical knowledge will only grow in importance. By blending traditional teaching wisdom with innovative technological approaches, teachers can create rich, dynamic, and meaningful learning experiences that prepare students for success in a rapidly changing world.

4.2 Teachers' Evolving Roles in Tech Integration

Today's coursebooks are no longer static repositories of knowledge; they are dynamic resources that actively shape and redefine teachers' roles in the classroom. In an era dominated by Information and Communication Technology (ICT), the role of teachers has expanded beyond traditional instruction to become facilitators of learning, curators of educational resources, and agents of technological integration. This shift not only transforms classroom dynamics but also significantly enhances students' learning experiences. However, achieving this requires teachers to acquire advanced ICT skills, critically reflect on their practices, and engage in ongoing professional development and research.

Teachers' beliefs, training, motivation, subject knowledge, and curriculum awareness profoundly impact textbook use. Unfortunately, to connect online and digital resources with the coursebook can be a daunting task that requires teachers to have a better understanding of pedagogical principles, technological competence, willingness to make more effort and sufficient time. Consequently, teachers with advanced pedagogical knowledge and effective training are more likely to adopt high-quality materials, adapt sequences, or even design their own resources to meet instructional demands.

As T7 mentioned in her interview: "I have known that in cities, many teachers can utilize some mobile apps to add images, pronunciation guides, and example sentences, making the vocabulary learning experience more enjoyable engaging. But my school is a county-level middle school and the rural students normally can have very little help or tutoring from parents, so mobile apps are not the possible choice for learning after class. Luckily, now with AI technology like Doubao, I can generate images, audios and even videos to add more fun for my students in class." Obviously, this case indicates that teachers act as facilitators in incorporating technology into teaching materials, ensuring the consistency with curriculum objectives, actual learning environment and enhancing the learning process. Their role involves evaluating the relevance and effectiveness of digital tools, such as language-learning apps, multimedia resources, and even AI generated learning contents. Additionally, teachers adapt traditional materials to incorporate technology. They may digitize textbooks, convert exercises into interactive formats, or integrate multimedia elements like audio and video recordings. This adaptation makes learning more dynamic, catering to various learning styles—visual, auditory, and kinesthetic, encouraging student participation.

One of the significant contributions of teachers is designing personalized learning experiences by leveraging technology. Digital tools enable teachers to customize teaching materials to suit the needs of individual students or groups. Being proud of a creative designer, T1 shared her practice of incorporating technology in her material designing: "I myself have developed the habits of reading some digital English news and also in my internship I was trained to use task-based teaching approach. So I tried to use the digital resources of 21st-century Teen newspaper to design personalized learning materials for my students. I first surveyed the class to understand each student's interests, such as sports, politics, or environmental issues. Based on these interests, I curated a list of recent articles and audios as report tasks with follow-up discussion for my students. This sparked their interest since they can choose the news item they like and the tasks fostered a deeper connection to real-world updates. And some news is related to our Chinese culture very closely, making students realize they can use English in Chinese context."As the key material designers, teachers can tailor content dynamically, ensuring that students receive materials aligned with their interests and preferences. Furthermore, personalization also extends to cultural and contextual relevance. Teachers can curate materials that incorporate local contexts or address students' interests, making learning more relatable. By embedding audios, videos, and quizzes, tasks into lesson plans, the teacher can ensure that the content resonates with learners while maintaining academic rigor.

Another important role for teachers in the tech-incorporation into teaching materials is to serve as a tech problem-solver. The integration of technology into English teaching materials is not without challenges, and teachers often act as tech fixers. They address issues such as the digital divide, where unequal access to technology can hinder student participation. Teachers mitigate this by providing offline alternatives, such as downloadable resources or printed materials, and advocating for equitable access to technology in schools. This is consistent with T4's teaching practices: "You know, my school is in the rural area and we do not have tech support for our multi-media facilities sometimes. And for some reason, which we the teachers have no idea of why, the Internet connectivity is not so solid. We are supposed to use the interactive whiteboard but the snail loading time is really troublesome! Luckily, I am a tech-savvy person so I would download some audios or shot-screen some videos ahead of time to facilitate my day-to-day teaching." This case demonstrates that teachers must manage technical difficulties, such as software malfunctions or connectivity issues. This requires a proactive approach, including troubleshooting problems, seeking technical support, and maintaining a backup plan to ensure continuity in teaching.

Overall, today's education has witnessed teachers' evolving roles in integrating technology into the design and use of English teaching materials. Their roles as facilitators, designers, promoters of material use, and problem-solvers, help teaching embrace technology and adapt to the potential tech challenges. By filling into those roles, teachers can create engaging, personalized, and effective learning experiences that prepare students for a technologically driven world.

4.3 Supporting Systems

The integration of technology into English teaching materials has offered vast potential to enhance learning experiences. However, this integration requires a sound supporting system to ensure its effectiveness, accessibility, and sustainability. Such a system involves professional development for teachers, access to technology infrastructure, institutional support, collaboration among stakeholders, and an emphasis on research and innovation.

At the first place, a robust teacher training system is fundamental to effective technology integration. Teachers must be equipped with the technical skills and pedagogical knowledge to utilize technology effectively in designing and using English teaching materials. As T8 stated: "I am so grateful that I can have the opportunity to attend a seminar that provided language teaching related AI application. There, I learned some practical prompts to design my teaching materials. That helps a lot in my teaching." However, T5 aired the opposite opinion: "I think some training programs are less effective since they require us to develop information communication technology ability only by focusing on the technical skills rather than on how to adapt technology across various teaching circumstances. Kind of disappointed." Many teachers lack the skills needed to integrate technology effectively so more comprehensive and targeted training programs and mentorship opportunities can bridge this gap. As a result, training programs should include hands-on workshops on using AI, multimedia editing software, and online collaboration platforms. For instance, mastering some basic AI prompts can enable teachers to create engaging digital content and facilitate virtual learning.

For technology to be effectively integrated into English teaching materials, adequate infrastructure must be in place. This includes providing schools and educators with the necessary tools, hardware, and software. The two participants from the rural areas both expressed their complaints about the relatively unreliable hardware. Schools should be equipped with devices such as computers, tablets, and interactive whiteboards. In addition, personal devices for teachers and students enable the seamless creation and use of digital teaching materials. Reliable internet access is crucial for the use of online tools and resources. Governments and institutions should work to bridge the digital divide, ensuring equitable access to high-speed internet for all schools, including those in rural or underprivileged areas. Equally important, institutions must provide access to licensed software for designing and delivering teaching materials. This includes language learning apps and some other multimedia tools. The accompanying information communication technology components in many textbooks, such software packages should provide sufficient guidance for teachers as well.

In China's highly exam-focused educational environment, teachers often face the dual pressures of covering extensive curriculum content and preparing students for high-stakes examinations. Integrating technology into English teaching materials can build up these pressures, as the alignment of digital resources with the mandated curriculum and examination goals may not always be straightforward. T2

aired her opinion by saying that: "I want to implement interactive language-learning apps to enhance students' listening and speaking skills. These apps often feature engaging, communicative tasks that foster real-world language use. While beneficial for developing fluency, such activities might not align directly with the grammatical precision and vocabulary control emphasized in China's Gaokao (college entrance examination). I must decide whether to allocate precious classroom time to these technologically enriched exercises or to focus on exam-specific drills." This mismatch often places teachers in a difficult position. To address this challenge, educational policymakers and material developers need to work collaboratively to design tech-integrated resources that are aligned with curriculum objectives and examination formats.

Time constraints are a recurring issue for teachers in China striving to integrate technology into English teaching materials. The extensive curriculum, combined with the fixed number of teaching hours, leaves little room for innovative practices. Teachers must often make hard choices about whether to use traditional methods that efficiently cover content or experiment with technology-enhanced learning. To alleviate these constraints, schools and policymakers can play a critical role. First, they could provide additional teaching hours or flexible scheduling to accommodate tech-based innovations without sacrificing syllabus coverage. Second, integrating technology into the official curriculum as a complementary rather than supplementary tool can encourage teachers to use these resources without fear of derailing their pacing plans.

5. Conclusion

The study identifies teachers' pedagogical knowledge as the mainstay to integrate technology into English teaching material design and use. Findings highlight how pedagogical theories, such as Activity Theory, Task-Based Language Teaching (TBLT), Constructivism, and Cognitive Load Theory, can guide effective technology adoption. The study also addresses the evolving roles of teachers in technology-rich classrooms, highlighting challenges like the pressure of curriculum alignment and the need for robust support systems.

Teachers' pedagogical knowledge shapes the purposeful selection, design, and use of tech-enhanced materials. In turn, teaching materials, when integrated with ICT, can redefine the role of teachers, making them facilitators, designer and tech mediator to generate enriched, student-centered learning experiences. However, this transformation requires more than basic ICT knowledge. It demands teachers who are committed to professional growth, reflective practice, and research-driven innovation.

The findings also highlight the importance of institutional support, teacher training, and infrastructure development. Professional development programs focusing on pedagogical integration of technology, along with reliable tech resources, empower teachers to use digital tools effectively. Policy-level support, such as incorporating tech-enhanced materials into the official curriculum, can mitigate the pressure of time constraints and curriculum alignment.

Drawing on the results from multi-sources, the study advances understanding of how teachers' pedagogical knowledge underpins successful technology integration. By linking theoretical frameworks with practical applications, it provides actionable insights into designing tech-enhanced English materials. Additionally, addressing systemic challenges through policy recommendations and support systems contributes to creating sustainable, impactful teaching practices. This study could offer some insight into the interplay between pedagogy and technology, rolling out a roadmap for future innovation in English language education.

Funding

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Author Profile

Yanshen Yu received B.S. degree in English from Northeast Normal University in 2002 and M.S. degree in Theoretical Linguistics & Foreign Applied Linguistics from Shanghai University in 2009. She is a lecturer in School of Foreign Studies, Lingnan Normal University, Zhanjiang, PRC. Her research focuses on applied linguistics, intercultural communication and Business English.