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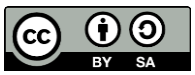

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Navigating Problem-Based Learning in English Teaching in a Low-Tech Environment: A Case Study

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Abstract

This study explores the implementation of Problem-Based Learning (PBL) in vocational high schools operating within low-technology environments. Conducted as a qualitative case study in a private vocational institution in rural Jember, Indonesia, the research specifically investigates the strategies and challenges faced by English teachers when applying PBL without adequate technological support. Data were collected from six English teachers through semi-structured interviews and open-ended questionnaires, all of whom had at least ten years of teaching experience and were familiar with PBL-oriented instruction. The findings reveal that teachers consistently demonstrated strong adaptability and creativity despite limited access to digital tools such as projectors, internet connectivity, or multimedia resources. Several low-tech instructional strategies emerged, including the use of printed case materials, real-life problem-solving activities, paper-based dictionaries, and collaborative group discussions. Approximately 70% of teachers reported relying heavily on printed materials to replace digital media, while more than half noted that vocabulary-focused techniques were essential to support students with limited digital literacy. These adaptations illustrate high levels of teacher agency and pedagogical resilience in maintaining the quality of instruction under technological constraints. The study concludes that PBL can still be effectively implemented in low-tech classrooms through context-responsive innovation and collaborative teacher practices. These insights offer practical implications for educators, policymakers, and teacher training institutions seeking to strengthen instructional quality in resource-constrained settings. However, the study is limited by its small sample size and its focus on a single school context, indicating the need for further research across broader vocational environments.

Keywords: *Problem-Based Learning, teacher agency, vocational education, low-tech classrooms, English teaching*

Introduction

The rapid technological developments characterizing Society 5.0 and the Fourth Industrial Revolution have profoundly transformed various sectors, including education. In the context of vocational training, digital literacy and equitable access to technology are increasingly recognized as essential foundations for improving students' work readiness and global competitiveness (Urwick 2022). Within vocational education—which emphasizes practical, industry-oriented competencies—digital tools have been identified as valuable resources for enriching English language learning by making instructional activities more interactive, efficient, and accessible (astuti, Riviyanti, and Azwar Abbas 2024)

Despite these global trends, many vocational high schools in Indonesia continue to face substantial infrastructure and regulatory barriers that hinder the effective integration of technology. Several institutions operate with limited access to digital devices, unstable internet connectivity, and restrictive policies surrounding the use of personal mobile phones (Azzahra 2024) These conditions remain prevalent even as national policies increasingly encourage the adoption of digital innovations in teaching and school administration (Fadhilah 2024) One example of this situation is a private vocational school located in Jember, East Java, which serves as the site of the present study.

The school lacks essential technological facilities such as projectors and reliable internet access and enforces strict regulations prohibiting students from using mobile phones unless explicitly permitted by the teacher. Such limitations pose significant challenges for both teachers and learners, especially when attempting to incorporate digital tools in English instruction. As noted by (Tao and Gao 2022) inadequate access to technology, insufficient technical support, and limited digital training often hinders the effectiveness of language learning in low-resource settings. These conditions make the selected school highly relevant for investigating how English teaching can be adapted to low-tech environments.

This study is situated within broader discussions on vocational education development in Indonesia, which encompasses its historical evolution, current initiatives, opportunities, and enduring challenges (Suharno, Pambudi, and Harjanto 2020) Although vocational education has received increasing scholarly attention, research focusing specifically on English teaching in low-technology settings remains limited. This study seeks to contribute by offering practical insights for institutions facing similar technological constraints, especially through an emphasis on school–industry collaboration and work-based learning principles. Teachers in low-tech vocational schools must navigate a complex combination of limited digital access, inadequate classroom infrastructure, and large student populations (Singh 2024); (Mulyanti, Purnama, and Pawinanto 2020)

To manage these challenges, English teachers commonly employ adaptive instructional strategies such as interactive analog activities, vocabulary reinforcement, and the selective use of personal devices. These practices reflect

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elements of pedagogical resilience, understood as the capacity to sustain effective teaching through creative adjustments under persistent constraints (Day and Gu 2013) They also demonstrate teacher agency, defined as teachers' ability to independently make informed instructional decisions, innovate, and respond to contextual demands (Emans et al. 2025).

Although several studies have examined the experiences of teachers adapting to technology use in urban and rural contexts, research specifically addressing vocational schools with very limited technological access remains scarce. Prior studies (Kau 2024); (Mulyanti et al. 2020) have mostly focused on digital gaps and infrastructure disparities without exploring how English teachers develop concrete pedagogical strategies to address these limitations. Additionally, while Project-Based Learning (PBL) and Problem-Based Learning have been widely acknowledged for their potential to enhance language proficiency and critical thinking (Iskandar et al. 2021), most of these studies were conducted in schools with more adequate technological resources. Only a few scholars have explored how PBL is adapted for English instruction in environments where digital tools are scarce or unavailable. Furthermore, discussions on how teacher agency and pedagogical resilience shape PBL implementation in low-tech vocational classrooms remain largely underrepresented in both national and international research.

Addressing these gaps, the present study examines how vocational English teachers in Indonesia design and adapt PBL-based instruction in response to ongoing technological limitations. While PBL typically incorporates digital media, it can also be implemented effectively through analog materials, real-world problem-solving tasks, group discussions, and text-based activities. PBL has long been recognized as a model that promotes inquiry, collaboration, and deeper conceptual understanding (Hmelo-Silver 2004) Recent research suggests that PBL remains capable of improving students' engagement, language skills, and critical thinking even in low-tech environments (Hafizah et al. 2024); (Ni'mah et al. 2024).

The distinctive contribution of this study lies in its contextual emphasis on how English teachers maintain instructional quality and exercise teacher agency despite the absence of digital resources—an area that remains insufficiently explored in vocational education literature (Putri, Setyaningsih, and Putra 2021) Given its relevance for policymakers, teacher training institutions, and practitioners operating in limited-resource settings, this study aims to provide context-specific insights that may guide the development of effective low-tech teaching strategies. Therefore, the objectives of this study are to:

1. Identify the challenges experienced by English instructors in vocational schools with limited technological support.
2. Examine the strategies employed by teachers to overcome these challenges, particularly within PBL-oriented instruction, and provide contextually relevant insights for similar educational environments.

Method

This study employed a qualitative descriptive design, which, according to (Creswell & Poth, 2018 2025), enables researchers to explore and interpret phenomena deeply within their natural contexts. In addition, this research adopted a case study design, following (Yin 2018) who emphasizes that case studies are appropriate for investigating complex educational issues when the boundaries between the phenomenon and the context are not clearly defined.

Participants and Data Sources

The participants consisted of six English teachers from a private vocational school. A purposive sampling technique was used to select participants based on specific criteria relevant to the study. (Patton 2014) explains that purposive sampling aims to identify information-rich cases that can provide deep insights into the phenomenon under investigation. The inclusion criteria were: Active English teachers at the selected school, teaching experience ranging from 5 to 16 years, a minimum of five years of experience implementing PBL in low technology conditions.

Table 1: the data from participants

Participants	Teaching Experience	Age	Experience in using PBL with limited technology
P1	16 years	40 years old	6 years
P2	5 years	28 years old	5 years
P3	10 years	33 years old	5 years
P4	11 years	36 years old	6 years
P5	14 years	38 years old	7 years
P6	10 years	25 years old	5 years

Table 1 serves to displaying participant screening data, namely ensuring they meet the research inclusion criteria: Actively teaching English, Minimum 5–16 years teaching experience, accustomed to implementing PBL in limited technology conditions (5–7 years). Provides an overview of the age distribution and experience of participants that shows they are experienced enough and relevant for this study.

Instruments and Data Collections

The data for this research were obtained from two primary instruments, namely semi-structured interviews, and open-ended questionnaires**.** The use of multiple instruments was intended to conduct method triangulation, which (Denzin 2012) identifies as an important strategy for enhancing the credibility and accuracy of qualitative data.

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Data Collection

Data collection took place between January to March. Semi-structured interviews were conducted with three English teachers who agreed to participate and were available at the time of data collection. The interviews explored their teaching experiences, perceptions of PBL, classroom strategies, and the challenges encountered in low-technology settings. Each session took around 30 to 45 minutes and was audio-recorded after obtaining participants' consent of the participans.

Open-ended Questionnaires Six Additional English teachers were given an open-ended questionnaire. The questions are designed to explore the same thematic areas as the interviews, including PBL implementation, teacher agency, and resilience. The use of open-ended responses allows participants to freely outline their teaching practices and contextual challenges.

Data Analysis Procedure

Data were processed by employing the interactive approach outlined by (Miles, Huberman, and Saldana 2014), involving stages of data condensation, data display, and conclusion formulation and verification."

1. During the data reduction stage, the information collected from interviews and questionnaires was systematically categorized, coded, and simplified to highlight essential patterns and core findings.
2. The data display phase involved systematically presenting the reduced data in narrative and thematic forms to illustrate teachers' strategies and contextual challenges.
3. In the final stage of drawing and verifying conclusions, the researchers repeatedly reviewed and interpreted the data to verify that the identified themes are dependable and valid reflections of the data collected.
4. The process was cyclical and continuous, allowing insights to evolve as the researcher revisited and refined the data multiple times.

Validation and Trustworthiness

All research instruments were validated by two experts in English education to guarantee clarity, precision, and relevance of the content. The questionnaire achieved a Cronbach's Alpha of 0.78, indicating an acceptable level of internal consistency *(Tavakol and Dennick 2011)* To uphold the rigor of the qualitative analysis, this study applied four main trustworthiness criteria—namely credibility, dependability, confirmability, and transferability—as described by *(Enworo 2023)* which continue to serve as foundational standards in contemporary qualitative validation.

1. Credibility was reinforced through data triangulation involving interviews, questionnaires, and classroom observations.
2. Dependability was ensured through systematic documentation of research

procedures, maintaining consistency and transparency.

3. Confirmability was enhanced by keeping a reflective journal and conducting peer debriefing sessions with the academic supervisor to minimize researcher bias.
4. Transferability was accomplished by providing rich contextual descriptions of the research setting, enabling readers to apply the findings to similar educational contexts.

These integrated strategies ensured that the findings were trustworthy, reliable, and accurately represented the genuine experiences of teachers navigating English instruction in environments with limited technology.

Ethical Considerations

All participants were informed about the purpose of the study and provided written consent. Their identities were kept confidential, and permission was granted for audio recording during interviews. Ethical approval was obtained from the Faculty of Teacher Training and Education, Universitas Muhammadiyah Jember.

Results

This section presents the findings derived from semi-structured interviews and open-ended questionnaires administered to six English teachers. The results are organized into three major themes: (1) Challenges in Implementing PBL in Low-Tech Environments**,** (2) Strategies Adopted to Overcome Technological Limitations**,** and (3) Teacher Agency and Pedagogical Adaptation. Each theme is supported by direct participant statements to illustrate their lived experiences. Challenges in Implementing PBL in Low Tech Environments there are limited acces to digital tools. All participating teachers reported serious constraints related to the absence of essential technological resources such as projectors, computers, stable internet, or multimedia equipment. These limitations significantly reduced their ability to provide digital-based PBL activities.

One teacher explained: *"At our school, there are no LCDs or stable internet. When I want to show material, I have to draw or rewrite it on the board." (W-P3).* Another teacher emphasized that even simple tasks such as showing videos or digital texts were nearly impossible: *"I want to use video listening, but the facilities are not available. Students are also not allowed to bring cell phones unless there are special instructions." (W-P1).* Limited access to multimedia tools and infrastructure imbalances: While schools may have basic technology such as LCD projectors or speakers, the number of students and classes is much greater than the resources. As W-R3 notes: *"The facilities are complete, but not enough for all classes. We have to take turns and adapt accordingly." (W-P3)*

Digital policy restrictions and students' over-reliance on instant**:** teaching tools share concerns about students' reliance on Google Translate without understanding vocabulary. *"Many students are not yet accustomed to operating*

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applications; they are even confused about browsing." (Q-P4). In addition, strict school rules prohibit students from carrying mobile phones unless authorized by the teacher, making it difficult to use dictionary apps or internet searches during class. *"They just paste the Indonesian sentence and click. There is no attempt to understand vocabulary," (W-R2).*

Poor digital literacy and minimal training: Some questionnaire respondents reported inadequate professional development or workshops regarding technology-based teaching, especially for the context of PBL. One participant noted: *"We are rarely invited to technology-related training, and sometimes the material is too advanced for our facilities," (Q-P2).*

Findings from in-depth interviews and open questionnaires reveal that English teachers at rural private vocational schools in Jember face several significant challenges in technology integration. The most prominent barrier is the lack of supporting facilities for listening skills. As noted by W-R2, students tend to be unfamiliar with native speakers' accents because they have primarily been exposed to local songs, making English sound very foreign to them.

Additionally, the limited number of multimedia devices forces teachers to share projectors or speakers between classes, requiring them to adjust their schedules. School policies that restrict mobile phone use also pose challenges, especially since students often rely too heavily on Google Translate, lacking a deeper understanding of vocabulary. Some teachers highlighted the inadequacy of relevant ICT training; workshop materials are often too advanced compared to the actual facilities available at the school.

These findings affirm that limitations in digital infrastructure and school policies significantly affect the quality of language learning. Similar patterns were reported by (Sánchez-Rosas et al. 2022), who explored teachers' challenges in implementing distance learning during the pandemic in Indonesia, and by (Putri and Fitrawati 2024), who highlighted the persistence of the digital divide in rural education contexts.

Strategies Used by Teachers to Overcome Technological Obstacles Despite these difficulties, teachers demonstrate pedagogical resilience and agency through a variety of creative and low-tech instructional strategies. Use of realia and printed visual materials: Teachers creatively replace video or digital media with printed images, physical objects, and flashcards. For example, W-R3 describes how he teaches storytelling texts without video: "I used Soekarno's printed photos from magazines and newspapers and asked students to analyze them. From there, we discussed the context collaboratively."

Reviving dictionary-based learning: In response to the over-reliance on translation tools, W-R3 reintroduced paper dictionaries to students. This method promotes visual memory and vocabulary retention. "Opening a dictionary makes the eyes record vocabulary. This is more effective than automatic translation," (W-R3).

Problem-Based Learning with Local or Relatable Problems: Teachers design problem scenarios based on school life or local problems (e.g., text procedures). This situation allows students to engage in collaborative problem-solving without the need for digital tools. One teacher shared: "I use school sanitation problems. Students discuss it in groups and make posters as a solution," (Q-P5).

Group mixing and offline collaboration: Teachers intentionally mix students from different backgrounds (e.g., 'snooze' and 'snooze' students) so that those with limited access can benefit from group work and shared resources. Trigger learning using everyday expressions: Teachers take advantage of the previous knowledge that students use, i.e., those words and expressions without realizing they have mentioned them. The teacher does this when in class the students do not bring a dictionary. “When they don't know a word, I relate it to something they know in everyday life," (W-R3).

Despite numerous challenges, teachers demonstrate pedagogical resilience and high agency. They employ a range of cost-effective creative strategies, such as replacing videos with printed images, realia, and vocabulary cards. As explained by W-R3, teachers use photos of Soekarno from magazines and newspapers to stimulate narrative discussions without needing video.

To address dependence on automatic translators, teachers reintroduce printed dictionaries to help students develop a more natural visual memory of vocabulary. They also create problem scenarios based on everyday life, such as discussing school cleanliness issues in groups and then presenting them on posters. This strategy facilitates project-based learning (PBL) without digital devices. Teachers intentionally group students with diverse skill backgrounds to foster collaboration and informal knowledge transfer.

This adaptive approach aligns with findings from (Çoban Sural and Yaşar Sağlık 2024) and (Pramesti, Manurung, and Aminah 2023), emphasizing that PBL can succeed even in analog settings if teachers creatively utilize local contexts. This also illustrates that the quality of learning is not solely determined by technology, but more by teachers' initiatives to adjust methods to classroom realities.

Peer Supported Collaboration and Innovation collaboration between teachers plays an important role in overcoming technological limitations. Teachers often distribute leaflets, worksheets, and lesson plans tailored to the delivery of analog PBL. *"If I have printed materials or ideas, I usually share them with others. We support each other," (Q-P4).* This peer support system helps ensure consistent instructional quality despite uneven access to resources.

Collaboration among teachers also emerges as a crucial factor. In many cases, teachers exchange worksheets, printed materials, and ideas to design analog based PBL. Q-P4 even mentioned that if he has additional printed materials, he immediately shares them with other teachers. This model of solidarity helps maintain consistent teaching quality despite uneven facilities.

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Moreover, informal discussions among teachers often serve as a space for exploring practical contextual solutions, given that there are no standard guidelines for implementing PBL in low-tech environments. Thus, innovation grows not from top-down instructions, but from mutual support practices.

This collaborative practice underscores the importance of the teacher community in developing relevant teaching strategies, aligning with (Day and Gu 2013) view on "school resilience," which is built not only by individuals but through a culture of professional cooperation. Consequently, peer teaching collaboration proves to be a vital pillar for the success of PBL in schools with limited digital resources.

Table 2: Summary of the Main Themes

Theme	**Source**	**Description**
Technological Barriers	Interviews & Questionnaires	Lack of listening tools, digital policies, minimal training
Adaptation Strategy	Interviews & Questionnaires	Print media, realia, dictionaries local editions for PBL
Teacher Resilience	Both	Literacy-based teaching, cultural relevance, peer sharing, teaching collaboration
Low-Tech PBL Practices	Both	Posters, group discussions, analog problem-solving

Table 2 contains about Summarize the findings briefly in the form of themes. Show where the data sources were obtained (whether only interviews, only questionnaires, or both). Briefly explain the contents of the findings according to the theme. Technological Barriers: shows the main problems teachers have with listening facilities, digital usage policies, & lack of technology training. Adaptation Strategy: how teachers overcome limitations with printed media, realia, dictionaries, and local contexts. Teacher Resilience: describes the fighting power of teachers who utilize literacy, surrounding culture, & collaboration. Low-Tech PBL Practices: analog PBL practices such as poster making, group discussions, manual problem solving.

Discussion

This section discusses the findings in relation to existing literature and theoretical perspectives on PBL, teacher agency, and low-tech instructional environments. The discussion is organized into three major themes: (1) Navigating Technological Limitations in Vocational Settings**,** (2) Adaptive Strategies in Low-Tech PBL Implementation**,** and (3) Teacher Agency and Pedagogical Resilience in Constrained Contexts**.** Each theme highlights how the study contributes to ongoing scholarly conversations within vocational English education.

1. Navigating Technological Limitations in Vocational Settings

The findings demonstrate that English teachers in the studied vocational school face persistent technological constraints, including limited access to projectors, unstable internet connectivity, and strict phone-use policies. These barriers reflect broader patterns documented in Indonesian vocational education, where the integration of technology is hindered by infrastructural disparities and school-level regulations (Azzahra 2024); (Mulyanti et al. 2020) Importantly, the teachers' challenges align with (Tao and Gao 2022) assertion that limited resources and insufficient technical support significantly weaken the effectiveness of language instruction in low-resource settings.

The present study extends this understanding by showing that even routine PBL activities—such as presenting scenarios, conducting listening exercises, and accessing digital dictionaries—become difficult when technological supports are unavailable. These findings confirm earlier observations by (Singh 2024) that crowded classrooms and insufficient facilities compound the complexity of delivering communicative and learner-centered teaching in vocational schools. The present study offers context-specific evidence from a rural Indonesian setting, underscoring that the digital divide remains a major obstacle to equitable learning experiences in vocational English classrooms.

2. Adaptive Strategies in Low Tech PBL Implementation

Despite these constraints, teachers in the study demonstrated effective adaptation by redesigning PBL activities into low-tech formats. This aligns with prior research showing that PBL remains viable even in resource-limited schools when teachers contextualize learning through analog materials, real-world scenarios, and collaborative tasks (Hafizah et al. 2024); (Ni'mah et al. 2024) The use of printed worksheets, text-based case studies, and teacher-constructed materials reflects what Putri, Setyaningsih, and Putra (2021) describe as "contextual analog PBL," where learning problems are derived from familiar daily-life situations to compensate for the absence of digital tools.

Similarly, vocabulary scaffolding through word lists and modeling supports students' comprehension, consistent with findings from Iskandar et al. (2021) that structured scaffolding enhances learners' engagement and contributes to successful PBL cycles. This study also highlights the selective use of mobile phones under teacher supervision. While school regulations generally restrict device usage, teachers negotiated flexibility to support key tasks such as vocabulary lookup. This aligns with Kau (2024), who argues that limited digital access does not entirely preclude the creative use of personal devices when integrated responsibly. Overall, these adaptive strategies reveal that PBL can be effectively restructured using low-tech alternatives without compromising its core principles—problem orientation, collaboration, and student-centered inquiry.

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3. Teacher Agency and Pedagogical Resilience in Constrained Contexts

The third major finding concerns the strong sense of agency and pedagogical resilience demonstrated by teachers. Their ability to autonomously design lessons, improvise solutions, and sustain student engagement reflects Day and Gu's (2013) concept of pedagogical resilience—the capacity to maintain effective teaching despite ongoing challenges. Teachers' decisions to adjust lesson plans on the spot, simplify tasks, or substitute digital elements with analog materials exemplify what Emans et al. (2025) identify as "situated teacher agency." This form of agency emerges when teachers make context-dependent decisions in response to immediate classroom realities.

The study contributes to existing scholarship by offering evidence that teacher agency is not limited to technologically advanced environments. Rather, it plays a critical role in maintaining instructional quality when digital supports are absent. This adds nuance to vocational education research, which often frames technology as a prerequisite for innovation, overlooking the inventive practices that emerge from low-resource conditions. Furthermore, the teachers' commitment to sustaining student motivation—despite lack of multimedia stimuli—demonstrates that meaningful student engagement does not rely solely on technology. Instead, interactive analog activities such as roleplay and collaborative problem-solving can effectively foster participation. This insight fills a gap in current literature, which tends to emphasize digital resourcefulness as the primary driver of engagement.

Contribution, Implications, and Limitations

1. Contribution to Knowledge

This study contributes to the growing body of research on PBL and teacher agency by providing a contextually grounded analysis of English instruction in a vocational school with extreme technological limitations. It offers empirical evidence that:

- PBL can be successfully adapted through analog, text-based, and discussion-oriented strategies.
- Teacher agency plays a central role in navigating low-tech constraints.
- Pedagogical resilience supports the sustained implementation of student-centered methods despite infrastructural barriers.

These contributions extend current discussions on technology integration by demonstrating that innovation is still possible in low-tech environments.

2. Practical Implications

The findings offer practical implications for:

- Policymakers**:** The need to address digital inequity in rural vocational schools.
- Teacher Training Institutions: Training programs should emphasize analog PBL strategies and classroom improvisation skills.

- School Administrators**:** Flexible policies regarding device use may support learning without compromising discipline.
- Teachers**:** Low-tech adaptations of PBL can still produce meaningful engagement and skill development.

3. Study Limitations

This study has several limitations that should be acknowledged:

- It focuses on a single school, which limits generalizability.
- The data rely on teacher perceptions without direct classroom observation.
- The sample size is small, although appropriate for a qualitative case study.

These limitations suggest directions for further research, including multi-site comparisons and classroom-based analyses of PBL practices in low-tech contexts.

Conclusion

This study investigated how English teachers in a vocational high school with limited technological resources implement Problem-Based Learning (PBL) and maintain instructional quality despite significant constraints. The findings show that teachers consistently demonstrated strong adaptability, creativity, and professional commitment in navigating technological limitations such as the absence of projectors, unstable internet access, and restricted use of students' mobile devices. Teachers employed a range of low-tech strategies—including printed materials, text-based problem scenarios, structured group discussions, vocabulary scaffolding, and selective use of personal devices—to sustain PBL practices.

These adaptations illustrate high levels of teacher agency, reflected in autonomous decision-making and flexible instructional planning. They also highlight pedagogical resilience, demonstrated through improvisation and continuous efforts to keep students motivated even without digital tools. The study concludes that PBL can be effectively implemented in vocational English classrooms even in low-tech environments, if teachers adapt learning activities to suit contextual constraints. This challenges the common assumption that PBL inherently requires sophisticated digital resources and emphasizes that meaningful learning can still occur through analog, collaborative, and problem-centered tasks.

The findings have several important implications. For policymakers, they underscore the urgent need to reduce the digital gap across vocational schools, particularly in rural areas. For teacher education programs, the results highlight the importance of preparing teachers with low-tech instructional strategies and adaptive problem-solving skills. For school administrators, flexible policies regarding device use and support for printed learning resources may significantly enhance instructional quality.

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Although this study offers valuable insights, its scope is limited to a single vocational school, and the data are based primarily on teacher self-reports. Future research could explore students' perspectives, conduct classroom observations, or compare practices across multiple schools to provide a more comprehensive view of PBL implementation in low-tech contexts. Overall, this study contributes to the growing literature on English instruction in resource-constrained environments by demonstrating that teacher agency and pedagogical resilience play a crucial role in sustaining student-centered learning strategies such as PBL. These findings may serve as a reference for educators and institutions facing similar challenges, offering practical examples of how effective teaching can be achieved without reliance on advanced technological infrastructure.

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