ISSN 3082-5326
Research Article

Design and Development of a Hybrid AI-Supported Filipino Reading Comprehension Application Using a Human-AI Adaptive Learning Framework

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International Journal of Interdisciplinary Viewpoints (2)9, 36-41, 2026
https://doi.org/10.64612/ijiv.v2i9.186

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Abstract
This study aimed to design, develop, and evaluate a hybrid AI-supported Filipino reading comprehension application for Grade 2 pupils based on a Human–AI Adaptive Learning Framework. The development addressed reading comprehension challenges identified at Ramon Magsaysay Elementary School by providing a localized digital learning tool integrating teacher-guided instruction and AI-assisted learning functionalities. A descriptive-developmental research design was employed, with Agile Methodology guiding the system development process. The application incorporated Filipino reading activities, speech support, AI-assisted voice recognition, adaptive questioning, and learner progress monitoring. Its acceptability was assessed using the Technology Acceptance Model (TAM), involving 10 information technology experts during the pre-deployment evaluation and 25 Filipino teachers following a three-week implementation period. The results yielded an overall average weighted mean of 4.80, interpreted as Strongly Agree, across perceived usefulness, perceived ease of use, and attitude toward using the application. These findings indicate favorable evaluations of the application's technical functionality, usability, and instructional relevance. The study demonstrates the potential of integrating human instructional guidance with AI-assisted adaptive features in developing localized digital resources for early-grade Filipino reading comprehension. However, the findings primarily establish user acceptability and do not independently demonstrate improvements in pupils' reading comprehension outcomes.

Keywords
AI in education, adaptive learning, reading comprehension, human–AI interaction, educational application, Technology Acceptance Model

How to Cite
Dandan, D., Cruz, M. M., Largo, J., Samulde , J., & Poculan , C. (2026). Design and Development of a Hybrid AI-Supported Filipino Reading Comprehension Application Using a Human-AI Adaptive Learning Framework. International Journal of Interdisciplinary Viewpoints, 2(9), 36–41. https://doi.org/10.64612/ijiv.v2i9.186

Received: 17 July 2026
Accepted: 28 August 2026
Published: 30 September 2026

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Peer Review Statement
This article underwent a double-anonymous peer review process in accordance with the editorial policies of the International Journal of Interdisciplinary Viewpoints. Both authors and reviewers remained anonymous throughout the review process.
Open Access Statement
The International Journal of Interdisciplinary Viewpoints is a fully open-access, peer-reviewed journal. All articles are freely available online immediately upon publication without subscription or access fees.
Funding Statement
The authors received no financial support for the research, authorship, and/or publication of this article.
Conflict of Interest
The authors declared no conflicts of interest.
Data Availability Statement
The data supporting the findings of this study are available from the corresponding author upon reasonable request.
Author Contributions
The authors contributed to conceptualization, methodology, investigation, writing—original draft preparation, writing—review and editing, and supervision. The authors approved the final manuscript.
Ethics Statement
This study was conducted in accordance with ethical standards.

INTRODUCTION

Reading comprehension is a fundamental literacy competency that enables learners to understand, interpret, and respond meaningfully to written information. It supports academic achievement, communication, and lifelong learning across educational contexts. However, reading proficiency remains a significant concern in many countries, particularly in developing educational systems where learners experience difficulties understanding texts, identifying central ideas, and interpreting written information. In the Philippines, the Programme for International Student Assessment (PISA) 2022

results indicated that only 24% of Filipino learners attained at least Level 2 proficiency in reading, highlighting persistent challenges in foundational literacy development (OECD, 2023). This situation emphasizes the importance of developing accessible, engaging, and contextually appropriate literacy interventions, particularly during the early stages of formal education.

In response to persistent literacy challenges, the Philippine Department of Education introduced the Hamon: Bawat Bata Bumabasa (3Bs) Initiative to strengthen foundational reading competencies among Filipino learners (Department of Education, 2019). At the local level, Ramon Magsaysay Elementary School in San Carlos City, Negros Occidental, identified low reading comprehension among Grade 2 pupils as an instructional concern and became the beneficiary of the present study. The identified need provides a practical basis for developing a digital intervention that incorporates Filipino reading materials, interactive activities, speech recognition, and text-to-speech technologies. The integration of these technologies may provide additional opportunities for guided reading practice and individualized instructional support.

Recent developments in artificial intelligence have expanded opportunities for adaptive and technology-supported education. AI-assisted learning systems can provide immediate feedback, support individualized learning activities, and adjust instructional assistance according to learners' responses. Existing research emphasizes the potential of artificial intelligence to personalize educational experiences by adapting instructional content, learning activities, and delivery according to learner needs (Gligorea et al., 2023). Similarly, intelligent tutoring systems demonstrate the potential of technology-supported instructional assistance, although their effectiveness varies according to system design and the nature of the learning task (Kulik & Fletcher, 2016; VanLehn, 2011). Nevertheless, the application of AI in education requires appropriate pedagogical guidance, human oversight, and consideration of learners' developmental characteristics (Holmes et al., 2019; Luckin et al., 2016; UNESCO, 2023).

Despite these developments, a contextual gap remains in the integration of localized Filipino reading materials, oral reading support, adaptive comprehension activities, teacher guidance, and progress monitoring within a single application designed for early-grade learners. Existing research has examined AI-supported learning and technology-assisted reading, including the potential contribution of AI-based tools to reading comprehension (Silor & Silor, 2025). However, the development of a localized Filipino reading application that combines these features within a teacher-guided Human-AI adaptive framework requires further investigation. This contextual and developmental gap provides the basis for designing an application that responds directly to the reading comprehension needs identified by the beneficiary school.

To address this gap, the present study aims to design, develop, and evaluate a hybrid AI-supported Filipino reading comprehension application for Grade 2 pupils using a Human-AI Adaptive Learning Framework. Specifically, it examines the application's technical acceptability through IT expert evaluation and its perceived usefulness, ease of use, and acceptability through teacher evaluation. The Technology Acceptance Model (TAM) provides the theoretical basis for examining users' perceptions and acceptance of the developed technology (Davis, 1989; Davis et al., 1989). The study involves 10 IT experts and 25 Filipino teachers, with Ramon Magsaysay Elementary School serving as its beneficiary. Its contribution lies in integrating localized Filipino literacy instruction, AI-assisted reading support, and teacher-guided learning within a single digital application. However, the evaluation focuses primarily on system acceptability and user perceptions rather than experimentally measured improvements in pupils' reading comprehension.

METHODOLOGY

Design

This study employed a descriptive-developmental research design to design, develop, and evaluate a hybrid AI-supported Filipino reading comprehension application for Grade 2 pupils. The developmental component focused on identifying requirements, designing the system, integrating AI-supported functionalities, and refining the application. The descriptive component assessed the application's technical acceptability and perceived usefulness among IT experts and Filipino teachers. The development process was guided by Agile Methodology, which supported iterative requirements identification, system development, testing, feedback collection, and refinement. Agile development emphasizes collaborative work, adaptive planning, and iterative improvement, making it suitable for developing software responsive to user requirements (Hoda et al., 2013). The Human-AI Adaptive Learning Framework served as the instructional foundation, positioning teachers as the primary instructional guides while allowing AI-supported features to provide additional reading assistance.

The Technology Acceptance Model (TAM) provided the basis for evaluating perceived usefulness, perceived ease of use, and attitude toward using the application. The model explains how users' perceptions of a technology influence their attitudes and acceptance of its use (Davis, 1989; Davis et al., 1989). Its subsequent theoretical extensions further explain the determinants of technology acceptance and the role of interventions in influencing users' perceptions (Venkatesh & Bala, 2008; Venkatesh & Davis, 2000).

Locale and Participants

The study was conducted at Ramon Magsaysay Elementary School, located along Azcona Street, San Carlos City, Negros Occidental, Philippines. The school identified low reading comprehension among its Grade 2 pupils and served as the beneficiary institution of the developed application. The study involved 35 respondents consisting of 10 IT experts and 25 Filipino teachers. The participants were selected based on their relevance to the technical and instructional evaluation of the developed application. The IT experts evaluated the application before deployment, focusing on functionality, interface design, usability, system performance, and AI-supported features. Meanwhile, the 25 Filipino teachers evaluated the application after three weeks of implementation, particularly its perceived usefulness, ease of use, and suitability for supporting Filipino reading comprehension instruction.

Table 1 presents the distribution of participants involved in the evaluation. Filipino teachers constituted the larger group because their evaluation focused on instructional relevance and usability, whereas IT experts provided technical

assessments before deployment. Grade 2 pupils were the intended beneficiaries and users of the application, with parents or guardians providing supervision during try-out activities. They were not included in the reported evaluation sample.

Table 1
Distribution of Study Participants

Respondents	Frequency	Percentage
IT Experts	10	28.57%
Filipino Teachers	25	71.43%
Total	35	100.00%

Instrument

The study utilized an adopted questionnaire based on the Technology Acceptance Model to evaluate the developed application. The instrument assessed perceived usefulness, perceived ease of use, behavioral intention to use, and relevant functional characteristics of the system. The use of TAM-based assessment is consistent with established technology acceptance research, which identifies perceived usefulness and perceived ease of use as important determinants of technology acceptance (Davis, 1989; Davis et al., 1989). Subsequent applications of the model have also examined technology acceptance in educational contexts, including digital academic reading and mobile technology-supported assessment (Lin & Yu, 2023; Ortiz-López et al., 2024). IT experts evaluated the application's technical characteristics, while Filipino teachers assessed its instructional relevance, usability, and acceptability. The questionnaire underwent content validation using the Content Validity Index (CVI) and reliability testing using Cronbach's alpha with passing marks.

Collection

Data collection involved two evaluation stages. First, IT experts assessed the developed application before its final deployment. Their evaluation focused on the application's functionality, interface design, usability, system performance, and AI-supported features. Second, Filipino teachers evaluated the application after three weeks of implementation. The researchers administered the TAM-based questionnaire to obtain participants' assessments of its usefulness, ease of use, and attitude toward using the application. Responses were organized into tables and interpreted using a Likert scale. Weighted means were calculated to summarize the evaluation results according to the descriptive interpretations used in the study.

Analysis

The study employed descriptive statistical analysis, particularly frequency counts, percentages, and weighted means, to summarize participant characteristics and evaluation responses. Frequency counts and percentages described the distribution of respondents, while weighted means summarized the participants' assessments of the application. The resulting mean scores were interpreted using the verbal categories established in the research questionnaire. The IT expert and teacher evaluations were treated as separate assessment groups to distinguish technical acceptability from instructional user perceptions.

Ethical Considerations

The researchers informed participants about the purpose of the study, the voluntary nature of their participation, and the confidentiality of their responses. Informed consent was obtained before data collection. Participant information was treated confidentially, and responses were used for research purposes. Because the intended users were Grade 2 pupils, appropriate parental or guardian supervision was provided during application try-out activities.

Limitations and Rigor

The study was limited to the technical and user acceptance evaluation of the developed application involving 10 IT experts and 25 Filipino teachers. Although the application was evaluated after three weeks of implementation, the reported results primarily represent expert and teacher perceptions rather than direct measurements of pupils' reading comprehension. The use of an adopted questionnaire, content validation, and reliability testing provided a basis for evaluating the instrument.

RESULTS AND DISCUSSION

The IT experts evaluated the application before deployment to determine its technical acceptability. The assessment focused on perceived usefulness, perceived ease of use, and attitude toward using the developed application. Table 2 shows that the application received favorable evaluations from IT experts across all three assessment dimensions. Perceived usefulness obtained the highest weighted mean, suggesting that the experts considered the system's functionalities appropriate for its intended purpose. Perceived ease of use and attitude toward using also received favorable ratings, indicating positive assessments of the application's usability and overall acceptability. The findings suggest that the integration of Filipino reading activities, speech recognition, text-to-speech functionality, feedback mechanisms, and progress monitoring was positively received by the technical evaluators. These features support the application's intended function as a digital reading support tool. The findings are consistent with the Technology Acceptance Model, which identifies perceived usefulness and perceived ease of use as important determinants of technology acceptance (Davis, 1989; Davis et al., 1989). The relationship between these constructs and technology adoption has also been examined through subsequent extensions of the model (Venkatesh & Bala, 2008; Venkatesh & Davis, 2000).

However, these ratings represent expert perceptions and should not be interpreted as objective evidence of system performance under all operating conditions. Additional technical testing involving response accuracy, processing time, system reliability, and speech recognition performance would provide stronger evidence of technical quality.

Following three weeks of implementation, 25 Filipino teachers evaluated the application based on its usability, perceived usefulness, and acceptability as an instructional support tool.

Table 2
Summary of IT Experts' Evaluation of the Application

Evaluation Parameters	Weighted Mean	Interpretation
Perceived Usefulness	4.85	Strongly Agree
Perceived Ease of Use	4.75	Strongly Agree
Attitude Toward Using	4.80	Strongly Agree
Overall Mean	4.80	Strongly Agree

Table 3 indicates that Filipino teachers expressed favorable perceptions of the developed application. The highest reported rating was for the level of acceptability among end users, suggesting that teachers considered the application suitable for supporting Filipino reading comprehension activities. Attitude toward using also received a positive evaluation, reflecting favorable perceptions following the implementation period. Perceived ease of use received the lowest weighted mean among the reported dimensions, although its interpretation remained Strongly Agree. This suggests that the application was generally considered manageable for instructional use. Nevertheless, continued refinement of navigation, instructional instructions, and interface accessibility may further improve its usability, particularly when used with young learners who require teacher or guardian supervision.

The findings are consistent with the Technology Acceptance Model, which emphasizes the importance of perceived usefulness and perceived ease of use in shaping users' attitudes toward technology adoption (Davis, 1989; Venkatesh & Davis, 2000). Research involving digital academic reading technologies and mobile assessment tools has also demonstrated the relevance of technology acceptance constructs in educational settings (Lin & Yu, 2023; Ortiz-López et al., 2024). Furthermore, teacher acceptance and resistance are important considerations when introducing educational technologies into instructional practice (Tzimas & Demetriadis, 2025). In the present study, positive teacher perceptions suggest that the application's interactive activities and monitoring features may complement existing classroom reading practices. However, favorable perceptions alone do not establish actual improvements in learner achievement.

Table 3
Summary of Filipino Teachers' Evaluation of the Application

Evaluation Parameters	Weighted Mean	Interpretation
Perceived Ease of Use	4.65	Strongly Agree
Attitude Toward Using	4.75	Strongly Agree
Level of Acceptability to End Users	4.78	Strongly Agree
Reported Average Mean	4.73	Strongly Agree

Features of the Developed Application

The developed application integrates interactive Filipino reading activities and AI-assisted functionalities intended to support Grade 2 pupils during reading and comprehension exercises.



Figure 1. Main Dashboard and Reading Interface of the Developed Application

The application screenshots illustrate the main dashboard, Filipino reading materials, and learner interface. The registration feature allows pupils to establish individual profiles, while the home interface organizes reading materials into accessible activities. The reading interface provides speech recognition, text-to-speech support, hints, and immediate feedback. These functionalities demonstrate how the application combines digital reading resources with AI-assisted learning support. The integration of individualized profiles and progress monitoring also provides opportunities for teachers to observe learner participation and identify areas requiring additional assistance. The design supports the Human-AI Adaptive Learning Framework by positioning the pupil at the center of the learning process while maintaining the teacher's instructional role.

The integration of adaptive learning features is consistent with research emphasizing the potential of AI to personalize instructional activities according to learner needs and performance (Gligorea et al., 2023). Nevertheless, the educational value of these features depends on their appropriate integration into instructional practice and the continued involvement of teachers in guiding learners (Holmes et al., 2019; UNESCO, 2023).



Figure 2. Assessment and Monitoring Features of the Developed Application

The original screenshots illustrate the application's assessment and monitoring interfaces. These include multiple-choice comprehension questions, word formation activities, fluent reading exercises, and progress monitoring features. The assessment component allows pupils to answer comprehension questions after reading activities, while the monitoring interface provides information about scores, activity completion, and individual performance. These functionalities may assist teachers in identifying learning difficulties and planning appropriate instructional support. The integration of AI-assisted feedback and teacher monitoring reflects the study's Human-AI Adaptive Learning Framework. Rather than replacing teacher intervention, the application provides additional digital support that can complement guided reading activities. This approach is consistent with human-centered perspectives on educational AI, which emphasize the complementary roles of automated learning support and human instructional expertise (Holmes et al., 2019; Luckin et al., 2016). Research on intelligent tutoring systems also highlights the importance of considering the instructional context when evaluating technology-supported learning assistance (Kulik & Fletcher, 2016; VanLehn, 2011).

Integration of Human Guidance and AI-Supported Learning

The application was developed using a Human-AI Adaptive Learning Framework in which the teacher remains the primary instructional guide and the AI component provides additional learning assistance. Pupils interact with Filipino reading passages, receive support through speech recognition and text-to-speech functionality, and complete comprehension activities. The voice evaluation module utilizes Google Cloud Speech-to-Text API v2 configured with the Filipino (Philippines) language code, fil-PH. Recorded oral reading responses are converted into text and compared with target words, phrases, or sentences stored in the application database. A rules-based similarity check is used to determine whether the transcription closely matches the expected response. Successful matches are recognized by the system, while unmatched responses may trigger hints, repetition, or teacher-assisted intervention. This configuration provides a technical mechanism for supporting oral reading practice. The approach is consistent with the broader direction of AI-supported education, in which digital systems provide learning assistance while teachers retain responsibility for instructional decisions and learner support (Holmes et al., 2019; Luckin et al., 2016; UNESCO, 2023).

However, speech recognition accuracy, transcription error rates, and the reliability of the matching procedure were not quantitatively reported in the available results. These performance indicators should be examined in future technical evaluations.

Overall Interpretation of the Findings

The combined findings indicate that the developed hybrid AI-supported Filipino reading comprehension application received favorable evaluations from IT experts and Filipino teachers. The technical evaluation suggests that the system was considered acceptable before deployment, while the teacher evaluation indicates positive perceptions of its instructional usefulness and usability after three weeks of implementation. The findings support the potential value of combining AI-assisted reading features with teacher-guided instruction. The application provides localized Filipino reading activities, oral reading assistance, comprehension exercises, and progress monitoring within a single digital environment. These features respond to the identified instructional needs of the beneficiary school and reflect the potential of AI-supported learning to provide adaptive and individualized educational assistance (Gligorea et al., 2023; Silor & Silor, 2025). The favorable acceptance results are also consistent with research emphasizing the role of perceived usefulness, ease of use, and user attitudes in educational technology adoption (Davis, 1989; Davis et al., 1989; Lin & Yu, 2023; Ortiz-López et al., 2024). Teacher acceptance is particularly relevant because educators are responsible for integrating technology into classroom activities and ensuring that digital tools support instructional objectives (Tzimas & Demetriadis, 2025).

Nevertheless, the results should be interpreted within the boundaries of the research design. Positive ratings from IT experts and teachers establish perceived acceptability but do not independently demonstrate improvements in pupils' reading comprehension. Consequently, the study provides evidence of application development and favorable user perceptions rather than definitive evidence of learning effectiveness. Future studies should employ direct reading comprehension assessments, including pretest-posttest procedures, to determine whether the application produces measurable improvements in learner performance.

Conclusion and Recommendations

The study successfully designed and developed a hybrid AI-supported Filipino reading comprehension application for Grade 2 pupils using a Human-AI Adaptive Learning Framework. The application integrates Filipino reading materials,

speech recognition, text-to-speech functionality, comprehension activities, feedback mechanisms, and progress monitoring to support reading instruction and learner engagement. Evaluation results revealed favorable perceptions among IT experts and Filipino teachers regarding the application's usefulness, ease of use, and overall acceptability. The study demonstrates the potential of integrating artificial intelligence into early-grade Filipino literacy instruction while maintaining the essential role of teachers in guiding learning activities and monitoring learner progress. However, since the evaluation primarily focused on technical acceptability and user perceptions, the study does not establish measurable improvements in pupils' reading comprehension. Therefore, the developed application represents a potentially valuable instructional support tool whose actual educational effectiveness requires further empirical investigation.

Based on the findings, the study recommends that Filipino teachers integrate the application into guided reading activities, remediation sessions, and supplementary literacy instruction, supported by appropriate teacher supervision and training to maximize its instructional potential. The application may also be enhanced through expanded learner progress reports, more adaptive reading levels, improved speech recognition evaluation, and additional parent or guardian access features. Furthermore, future researchers are encouraged to conduct effectiveness studies using direct assessments of pupils' reading comprehension, particularly through pretest-posttest designs and appropriate comparison groups. Implementation may also be extended to larger participant groups and additional schools to examine the application's applicability across different educational contexts. Finally, subsequent evaluations should provide complete instrument validation results, reliability coefficients, detailed statistical analyses, and technical performance indicators to strengthen the validity, transparency, and reproducibility of future research.

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