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Enhancing Reading Comprehension for Junior High School Students Using a Mobile App: Integrating Text to Audio Reading Application, Summarization, and Descriptive Data Analytics for Insights

[1] Lloyd Allen Arguelles, [2] Joseph Bernard Dugay, [3] Patrick Sevilla*, [4] Raymund Dioses, [5] Vivien Agustin, [6] Joseph Darwin Co, [7] Criselle Centeno

[1][2][3][4][5][6][7] College of Information Systems and Technology Management, Pamantasan ng Lungsod ng Maynila, Manila Philippines

Email: [1] lalarguelles2021@plm.edu.ph, [2] bjadugay2021@plm.edu.ph, [3] pdsevilla2021@plm.edu.ph, [4] rmdioses@plm.edu.ph, [5] vaagustin@plm.edu.ph, [6] jdcco@plm.edu.ph, [7] cjcenteno@plm.edu.ph

Abstract*— The Text to Audio Reading Application (TARA) is a mobile application developed to enhance reading comprehension among junior high school students by leveraging text-to-speech technology and descriptive data analytics. The application addresses key issues in traditional reading methods, which often fail to engage students and foster poor reading habits. TARA converts written text into audible content, accommodating various learning styles and preferences, and includes features for summarization and progress tracking to support personalized learning. The study evaluates the mobile application's effectiveness in improving students' reading comprehension and engagement. The text-to-speech feature provides adjustable reading speeds, allowing students to choose settings that best suit their needs. The summarization tool condenses complex texts into shorter versions, highlighting key points to aid in understanding. Progress tracking functionalities enable students to monitor improvements and identify areas needing further practice. The evaluation encompasses system performance metrics, usability aspects, reliability factors, and security measures, all examined through a comprehensive questionnaire. Results indicate significant improvements in students' reading engagement and comprehension, with high user satisfaction regarding TARA's ability to offer tailored learning experiences and actionable insights. The study demonstrates that TARA effectively addresses traditional reading challenges while maintaining high standards across all evaluated aspects, providing a valuable tool for enhancing educational outcomes and supporting student development in the digital age.

Index Terms*— Text-To-Speech, Progress Tracking, Reading Comprehension, Engagement, Summarization, Personalized Learning.

I. INTRODUCTION

Recent advancements in mobile technology have revolutionized educational tools, particularly through innovations like text-to-speech (TTS) applications. These tools convert written text into spoken words, offering an accessible and engaging method for improving reading comprehension among junior high school students. TTS applications cater to various learning styles by providing auditory content, which is beneficial for students who struggle with traditional reading methods. Moreover, integrating data analytics into these applications enhances their effectiveness. These tools can provide insights into students' learning patterns and comprehension levels by analyzing usage data, allowing for personalized learning experiences.

The absence of integrated analytics in many current applications limits educators' ability to track student progress, identify areas of difficulty, and tailor instruction to individual needs. Additionally, there is a gap in tools that effectively combine TTS technology with other supportive features such as text summarization and progress tracking, and the use of mobile device cameras instead of manual input which could potentially boost comprehension and retention rates among junior high school students.

This study focuses on developing a Text-to-Audio Reading Application (TARA) designed to improve reading comprehension for junior high school students. TARA will use TTS technology to convert physical and digital text into audio and include features for text summarization and progress tracking. The study aims to assess how effectively TARA enhances reading comprehension and supports personalized learning, contributing to the broader effort of integrating technology into education.

a) Statement of the Problem

The existing text-to-audio applications fail to engage and be efficiently used by junior high school students because of the need to manually type text one by one and lack progress tracking to help students identify their level of reading comprehension.

b) Statement of the Problem

The existing text-to-audio applications fail to engage and be efficiently used by junior high school students because of the need to manually type text one by one and lack progress tracking to help students identify their level of reading comprehension.

1) To develop a text-to-speech feature using text-to-speech API accessible through both the mobile camera and manual text input. The text-to-speech engine will offer a variety of voices and reading speeds to cater to individual preferences.
2) To implement a summarization feature using MeaningCloud API that automatically generates a shorter version of the text, highlighting key points and main ideas using the mobile application.
3) To track student progress over time using standardized reading comprehension quizzes approved by IELTS-certified experts and provide feedback using Firebase for descriptive data analytics.

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II. METHODS AND METHODOLOGY

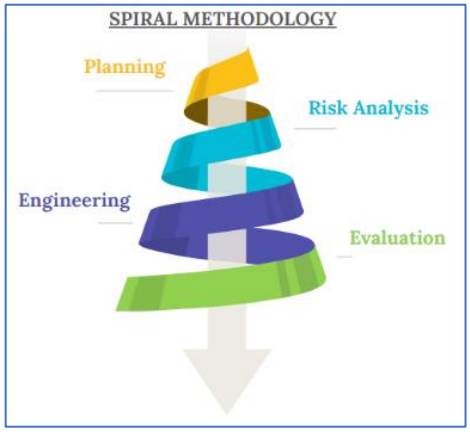

Figure 1. Spiral Methodology Model

The developers will adopt the Spiral Framework in developing and maintaining the output of the project. As illustrated in Figure 1, the developers will iteratively identify the requirements needed in the program, design the system, implement features, and verify functionality, with continuous evaluation and refinement. This iterative approach ensures flexibility and adaptability, accommodating changes and improvements throughout the development lifecycle.

(a) System Requirements

To develop the mobile application 'Enhancing Reading Comprehension for Junior High School Students Using a Mobile App: Integrating Text to Audio Reading Application, Summarization, and Descriptive Data Analytics for Insights', the researchers utilized specific software resources. The following are the software requirements that were used in creating the system:

Table 1 System Software

Description	Requirements
Planning and Design	Figma
	Canva
Integrated Development Environment (IDE)	Android Studio
	Visual Studio Code
Version Control	Github
Front End	XML
Back End	Kotlin
	Java
Database	Firebase

Figma and Canva serve as the primary tools for planning and prototyping the user interface design, as shown in Table 1; Android Studio and Visual Studio Code function as the primary Integrated Development Environments (IDEs) for coding and system development; GitHub facilitates version control and collaboration among developers; XML handles the frontend user interface design and layout structuring; Kotlin and Java power the backend business logic and server-side operations; and Firebase manages the database system, providing real-time data synchronization and cloud storage capabilities.

(b) Theoretical Framework

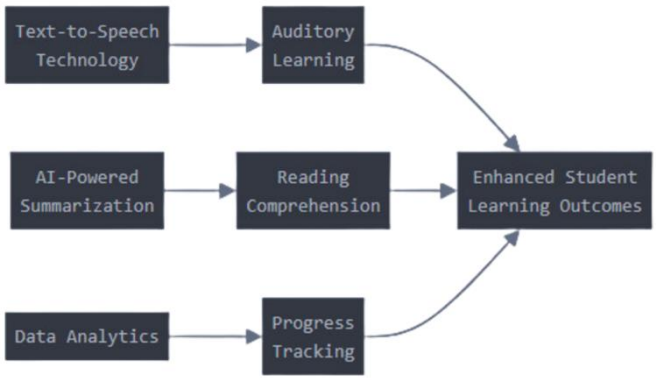

Figure 2. Spiral Methodology Model

The theoretical framework of the Text to Audio Reading Application (TARA), illustrated in Figure 2, is grounded in reading enhancement theory, particularly focusing on multimodal learning and personalized education. This theory suggests that providing multiple modes of content delivery (text and audio) enhances comprehension and retention. In this model, text-to-speech technology converts written content into audible format, making reading materials more accessible and engaging for students with different learning preferences.

The integration of AI-powered summarization helps students grasp key concepts more effectively by identifying and highlighting main ideas, while data analytics tracks student progress and adapts to individual learning patterns. This combination of technologies supports the theory that personalized, technology-enhanced learning leads to improved reading comprehension outcomes.

When new text is presented through TARA, the system applies these theoretical components to create a comprehensive learning experience: converting text to speech for auditory learners, generating summaries for better understanding, and using analytics to monitor and enhance student progress. This theoretical approach ultimately aims to achieve enhanced student learning outcomes through technological integration and personalized learning support.

(c) Conceptual Framework

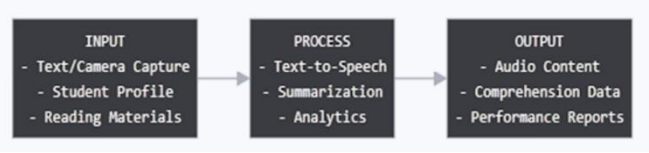

Figure 3 Conceptual Framework

The conceptual framework (Figure 3) illustrates the systematic flow of components and their interactions. At the input level, the system accepts text through camera capture or manual input, along with student profiles and reading materials. The processing layer, which serves as the system's core, utilizes three main components: the text-to-speech engine for audio conversion, text summarization for content simplification, and analytics processing for tracking progress. The output layer delivers three key results: converted audio content, comprehension data, and performance reports that help monitor student progress.

This framework demonstrates how the mobile app transforms raw input into meaningful learning outputs through its integrated processing components, creating a streamlined workflow from data collection to result generation. The system's architecture ensures

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efficient handling of text-to-speech conversion, summarization, and progress tracking, ultimately supporting the goal of enhanced reading comprehension for junior high school students.

(d) Data Collection Instruments

The developers will use questionnaires. A questionnaire is a tool used in research to compile data from participants by means of a set of questions in either a statistical or a survey form.

The questions are categorized using the ISO 25010:2011 criteria to assess functionality, performance, usability, reliability, and security and evaluation will be using the 4-point Likert Scale of Agreement (Table 2(a)).

Table 2(a). 4-Point Likert Scale of Agreement

Numerical Rating	Requirements
1	Very Acceptable
2	Acceptable
3	Unacceptable
4	Very Unacceptable

(e) Participants

The study involved 50 junior high school students who participated in testing and evaluating the TARA application. These students provided diverse feedback, helping assess the system's effectiveness across different criteria. This demographic was selected to align with the target user base of TARA and to ensure that feedback reflected real-world usage in an educational setting.

III. RESULT

(a) Functional Suitability

Table 3. Functional Suitability Evaluation

Criteria	Mean Score	Interpretation
Text-to-Speech Function	3.36	Acceptable
Text Summarization	3.34	Acceptable
Learning Goals	3.20	Acceptable
Feature Completeness	2.66	Acceptable
Task Appropriateness	3.40	Acceptable
Overall Mean	3.19	Acceptable

The system excels in functional suitability across several aspects as presented in Table 3. For text-to-speech functionality, respondents find it acceptable, with a mean score of 3.36, indicating high effectiveness. The system's accuracy in summarizing text content is praised, with a mean score of 3.34. Support for personalized learning goals is well-received, with a mean score of 3.20. While the inclusion and functionality of expected features shows room for improvement with a mean score of 2.66. The appropriateness of features for designed tasks is highly regarded, with a mean score of 3.40, reflecting strong overall satisfaction with the system's functional suitability.

(b) Performance Efficiency

Table 4. Performance Efficiency Evaluation

Criteria	Mean Score	Interpretation
Text-to-Speech Response	3.44	Acceptable
Processing Speed	3.30	Acceptable
Resource Usage	2.70	Acceptable
Multitasking	2.86	Acceptable
Usage Scenario	2.86	Acceptable
Overall Mean	3.03	Acceptable

The system's performance efficiency is generally well regarded (Table 4). Text-to-speech conversion responsiveness is excellent, with a mean score of 3.44. Timeliness in handling and summarizing texts is praised with a mean score of 3.30. However, device resource management shows room for optimization, with a mean score of 2.70. The system's capability to handle multiple tasks efficiently receives mixed feedback, with a mean score of 2.86. Performance under various usage scenarios achieved a mean score of 2.86, indicating general approval but with potential for enhancement.

(c) Usability

Table 5. Usability Evaluation

Criteria	Mean Score	Interpretation
Navigational Ease	3.32	Acceptable
Label Clarity	3.42	Acceptable
System Control	3.28	Acceptable
Instructions	3.36	Acceptable
Error Recovery	2.68	Acceptable
Overall Mean	3.21	Acceptable

As Table 5 indicates, the usability of the system is highly rated across various aspects. The interface's ease of navigation and use is praised with a mean score of 3.32. Feature and function labeling clarity is excellent, with a mean score of 3.42. System control and operation straightforwardness is well-received with a mean score of 3.28. The provision of clear instructions and guidance is highly appreciated, with a mean score of 3.36. While the system's error prevention and recovery assistance received a mean score of 2.68, suggesting an area for improvement in the overall user experience.

(d) Reliability

Table 6. Reliability Evaluation

Criteria	Mean Score	Interpretation
Performance	3.18	Acceptable
Recovery Time	2.90	Acceptable
Availability	3.44	Acceptable
Fault Tolerance	2.86	Acceptable
Overall Mean	3.10	Acceptable

The system's reliability shows strengths and areas for improvement as shown in Table 6. Consistency of performance without failures is positively viewed with a mean score of 3.18. Recovery from interruptions or failures achieved a mean score of 2.90. The system's availability and operability when needed is highly praised, with a mean score of 3.44. Resilience to faults or errors during operation received a mean score of 2.86, indicating general reliability but with room for enhancement.

(e) Security

Table 7. Security Evaluation

Criteria	Mean Score	Interpretation
Data Protection	3.38	Acceptable
Access Control	3.44	Acceptable
User Tracking	3.26	Acceptable
Identity Check	2.84	Acceptable
Overall Mean	3.23	Acceptable

According to Table 7, the system demonstrates strong security measures. Protection of user data and confidentiality is highly regarded, with a mean score of 3.38. Prevention of unauthorized access and data modifications is praised with a mean score of 3.44. The effectiveness in documenting user actions for accountability is

well received with a mean score of 3.26. However, the reliability in verifying user identities and preventing fraud shows room for improvement, indicating an area that may require further attention to enhance overall security.

IV. DISCUSSION

The evaluation data demonstrates TARA successfully achieved its objectives across key assessment criteria. The text-to-speech functionality received high acceptance (mean=3.36), with users particularly valuing its responsiveness (mean=3.44). The summarization feature proved effective (mean=3.34), though the system's handling of multiple tasks showed room for improvement (mean=2.86).

The interface design emerged as a significant strength, with clear feature labeling (mean=3.42) and intuitive navigation (mean=3.32). System availability scored well (mean=3.44), though error prevention mechanisms require enhancement (mean=2.68).

Security measures were notably robust, particularly in preventing unauthorized access (mean=3.44) and protecting user data (mean=3.38). However, device resource management needs optimization (mean=2.70).

V. CONCLUSION

The study successfully met its objectives, demonstrating significant progress in addressing reading challenges among junior high students through TARA. The integration of text-to-speech technology, summarization tools, and progress tracking created a comprehensive solution for diverse learning needs. While the system showed strong overall performance and high user satisfaction, some technical aspects like error handling need refinement. Nevertheless, the measurable improvements in reading comprehension validate TARA's effectiveness in enhancing digital education outcomes.

(a) Limitations

The app required a stable internet connection, which was not accessible to all students. The initial version supported only English texts, potentially limiting its effectiveness for non-English-speaking students. Furthermore, the mobile application was incompatible with iOS devices, and the text-to-speech functionality utilized American English exclusively. The application also did not support mathematical symbols and special characters.

(b) Future Work and Recommendations

The following recommendations are provided for emerging researchers seeking to enhance the system:

1) Audio Recording Feature: Allow students to record themselves reading aloud and compare it to the text-to-speech version for pronunciation practice.
2) Simple Dictionary Integration: Include a built-in dictionary for quick word lookups without leaving the app
3) Timed Reading Exercises: Introduce timed reading exercises to help students improve their reading speed and comprehension under time constraints.

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REFERENCES

[1] M. J. Quimsing and R. Ortega-Dela Cruz, "Technology-based reading application on improving reading literacy level among struggling readers in a public elementary school in the Philippines," *Pedagogy: Journal of English Language Teaching*, vol. 12, no. 1, 2024. doi: 10.32332/joelt.v12i1.7757.

[2] Global Education Monitoring Report Team and Philippine Normal University, "Technology in education: A case study on the Philippines," in A. A. Espinosa, M. A. C. Gomez, P. A. Miranda, A. P. David, E. L. R. Abulon, M. V. C. Hermosisima, E. A. Quinosa Jr, A. A. Soliman, J. L. De Vera, I. H. A. Claros, H. G. M. Cruz, and N. S. Gonzales, Eds., *Background paper prepared for the 2023 Global Education Monitoring Report: Technology and education, Southeast Asia*, vol. 17, 2023. doi: 10.54676/XKHI4627.

[3] O. J. Chavez and T. Palaoag, "AI-driven mobile application: Unraveling students' motivational feature preferences for reading comprehension," *Journal of Research in Innovative Teaching & Learning*, 2024. Available: https://www.emerald.com/insight/content/doi/10.1108/JRIT-02-2024-0045/full/html.

[4] A. O. Tinapay, R. Seno, D. L. Fernandez, J. Samillano, and S. L. Tirol, "Exploring student reading comprehension and parental intervention: A literature review," *IOER International Multidisciplinary Research Journal*, vol. 3, no. 4, 2021. Available: https://www.ioer-imrj.com/wp-content/uploads/2022/01/Exploring-Student-Reading-Comprehension-and-Parental-Intervention-A-Literature-Revie.pdf.

[5] J. R. Redondo and R. C. Catapang, "Contextualized interactive video as a reading tool for daycare pupils of selected barangay in Manila City amidst COVID-19," *Journal of Electrical Systems*, vol. 20, no. 5s, pp. 1720–1728, 2024. Available: https://www.proquest.com/openview/a08b5fc48939be6886bf7cbe0e7befb9/1?pq-origsite=gscholar&cbl=4433095.

[6] J. Sambayon, D. Luceñara, C. Luceñara, Q. Bayron, R. Peñaloga, and E. Larombe, "Effectiveness of contextualized learning materials in improving the reading skills and comprehension level of the students," *Psych Educ Multidisc J*, vol. 7, no. 6, pp. 435–445, 2023. doi: 10.5281/zenodo.7702258.

[7] M. Gatlabayan, "Enhancement of students' English vocabulary skills through a mobile assisted language learning (MALL) app," *Journal of Humanities, Education, Research, and Development (JHERD)*, vol. 9, no. 1, 2024. Available: https://www.nmsc.edu.ph/ojs/index.php/jherd/article/view/234.

[8] R. Manlapaz, S. Cabahug, and M. I. Divina, "Contextualized based-learning materials: An evaluation to enhance the reading comprehension of the Grade 7 students during the COVID-19 pandemic," *Psych Educ Multidisc J*, vol. 6, no. 3, pp. 206–213, 2022. doi: 10.5281/zenodo.7444558.

[9] G. Sagun, "Distance learners toward mobile-assisted language learning: Basis for gamified and mobile English learning development," *Psych Educ Multidisc J*, vol. 12, no. 10, pp. 1041–1055, 2023. doi: 10.5281/zenodo.8302327.

[10] C. A. L. Jaca, B. M. Tumulak III, and V. V. Boaquin, "Lived experiences among Grade 10 students in playing 4 Pics 1

Word for vocabulary learning," *Randwick International of Education and Linguistics Science Journal*, vol. 4, no. 1, pp. 20–34, 2023. doi: 10.47175/rielsj.v4i1.641.

[11] A. Villaflor and L. Jalos, "Effect of mobile assisted language learning (MALL) on the development of skills in writing by students of alternative learning system (ALS) in Guinayangan Senior High School," *Psych Educ Multidisc J*, vol. 16, no. 6, pp. 657–666, 2024. doi: 10.5281/zenodo.10527893.

[12] M. C. Mauricio and C. F. Genuino, "Writing performance and attitude of ESL learners engaged in smartphone-assisted collaborative activity," *LEARN Journal: Language Education and Acquisition Research Network*, vol. 13, no. 2, pp. 445–468, 2020. Available: https://eric.ed.gov/?id=EJ1258661.

[13] L. A. Mamolo and S. G. C. Sugano, "Digital interactive app and students' mathematics self-efficacy, anxiety, and achievement in the 'new normal'," *E-Learning and Digital Media*, 2023. doi: 10.1177/20427530231167646.

[14] L. M. C. R. Catapang and L. B. O. Medina, "Video animated stories: An innovative reading assessment scheme in improving comprehension skills among Grade 7 learners at Alitagtag National High School," *International Journal of Recent Innovations in Academic Research*, vol. 5, no. 12, pp. 62–70, 2021. doi: 10.5281/zenodo.5920190.

[15] A. M. Ater and J. Galibo, "Development and utilization of audio-video presentation to improve reading comprehension skills," *Psych Educ Multidisc J*, vol. 19, no. 6, pp. 638–648, 2024. doi: 10.5281/zenodo.11111257.

[16] M. P. Vidal, "Effectiveness of Multimedia and Text-Based Reading Approaches to Grade 10 Students' Reading Comprehension Skills," *AsiaCALL Online Journal*, vol. 13, no. 4, pp. 55–79, 2022. doi: 10.54855/acoj.221345.

[17] J. M. Magbanua, K. M. Emata, C. Aquino, H. Padayhag, R. Sonny, and F. Tan, "Audio books as motivation in the listening comprehension among Grade 3 learners," *Psych Educ Multidisc J*, vol. 15, no. 9, pp. 974–980, 2023. doi: 10.5281/zenodo.10427962.

[18] M. D. Catalan and D. N. Marcelo, "Development and validation of an audiobook in Afro-Asian literature," *Lukad: An Online Journal of Pedagogy*, vol. 2, no. 1, pp. 74–94, 2022. Available: https://lukad.org/wp-content/uploads/2022/08/74-94-Catalan-_-Marcelo.pdf.

[19] E. N. Cotiangco, N. J. Huraño, E. R. Sodoso, M. G. Sumagang, J. J. Jumao-as, J. Canoy, M. Picardal, and J. M. Sanchez, "Android-based audio-visual comics in enhancing conceptual understanding and motivation of chemistry concepts," *Orbital: The Electronic Journal of Chemistry*, vol. 16, no. 2, pp. 125–135, 2024. doi: 10.17807/orbital.v16i2.19953

[20] R. D. Enriquez, "Reading partnership between challenged and knowledgeable (Repack) readers to improve performance," *International Journal of Multidisciplinary: Applied Business and Education Research*, vol. 5, no. 6, pp. 2301–2307, 2024. doi: 10.11594/ijmaber.05.06.29