



The Effectiveness of the Project-Based Learning Model Assisted by Artificial Intelligence on the Listening Skills of Indonesian Language Education Students

Deby Luriawati Naryatmojo^{1(*)}, Bambang Hartono², Diyamon Prasadha³, Dyah Prabaningrum⁴, Aldi Dwi Saputra⁵

^{1,2,3,4}Universitas Negeri Semarang, Semarang, Indonesia

⁵Universitas Sebelas Maret, Surakarta, Indonesia

Abstract

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The integration of technology in Indonesian language learning has continued to develop alongside advances in Artificial Intelligence (AI), although its application in classroom practice remains limited. This study aims to examine the effectiveness of the Project-Based Learning (PjBL) model assisted by Artificial Intelligence in improving the listening skills of Indonesian Language Education students. The study employed a quasi-experimental design with two groups: an experimental group consisting of 23 students who received AI-assisted PjBL instruction and a control group consisting of 34 students who received conventional instruction. In the experimental group, AI was implemented through the use of speech-to-text tools and AI-based audio generators to support listening activities. Data were collected through pretests and posttests measuring listening skills, supported by observation and documentation. Data analysis included descriptive statistics, paired sample t-tests, independent sample t-tests, and N-gain analysis. The results showed that the AI-assisted PjBL model significantly improved students' listening skills. The experimental group achieved a higher mean score compared to the control group, with an N-gain score of 0.42 (moderate category), while the control group obtained an N-gain score of 0.21 (low category). These findings indicate that AI-assisted PjBL is more effective than conventional learning methods in enhancing listening skills. This study implies that integrating AI into project-based learning can support more interactive and meaningful listening instruction and contribute to the development of students' language skills in higher education contexts.

Keywords:

Artificial Intelligence; Indonesian Language Education; Listening Skills; Project Based Learning.

(*) Corresponding Author: debyluriawati@mail.unnes.ac.id

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INTRODUCTION

Listening skills constitute one of the fundamental language skills in language learning, including Indonesian language education at the higher education level (Budianto et al., 2023; Naryatmojo, 2019). Listening is not merely a passive activity of hearing sounds, but rather a complex cognitive process that involves understanding, interpreting, analyzing, and evaluating spoken information (Worthington, 2024). In academic contexts, strong listening skills are essential for university students to comprehend lecture materials, participate effectively in



discussions, and develop other language skills in an integrated manner (Qasserras, 2025).

However, the teaching of listening skills in higher education still faces several challenges (Pham & Le, 2025). Learning activities tend to rely on conventional approaches that are lecturer-centered and provide limited opportunities for active student engagement (Muhammad & Setiawan, 2025). As a result, students' critical listening skills remain underdeveloped, particularly in processing complex and contextual oral information (Prihatin, 2017). In addition, the limited use of varied and interactive learning media often leads to low student motivation and decreased attention during listening activities (Hanafi & Rasyid, 2025).

Along with the rapid advancement of digital technology, particularly artificial intelligence (AI), there is an opportunity to support listening instruction through more varied and interactive learning resources (Brada & Dahmani, 2024; Kusumaningsih et al., 2025). Previous studies have shown that AI can facilitate the development of multimodal learning materials and support learning processes through audio, text, and visual integration (Vistorte, 2024; Negrila, 2023). In listening instruction, AI can be used to provide audio-visual resources and assist students in analyzing listening performance (Widiananda et al., 2023). Tools such as speech-to-text applications and AI-based audio generators enable learners to access diverse listening materials and review their comprehension through transcription and analysis activities (Naryatmojo, 2019). In this study, AI is positioned as a supporting tool to facilitate listening practice rather than as a fully adaptive or personalized learning system.

In addition to technological support, the selection of an appropriate learning model plays a crucial role in improving listening skills. Project Based Learning (PjBL) is a learning model that emphasizes active student participation through contextual and collaborative project activities (Wijaya et al., 2021). Through PjBL, students are encouraged to construct knowledge independently, collaborate with peers, and develop critical and reflective thinking skills (Uswatun & Kurniati, 2024). Several studies have demonstrated that the implementation of Project Based Learning (PjBL) is effective in improving various language skills (Kusmiarti et al., 2025). Saputra et al. (2025) reported that the PjBL model significantly enhanced students' ability in writing procedural texts. Similarly, a study conducted by Tarigan and Efrizah (2023) revealed that the application of PjBL contributed to the improvement of students' English speaking skills. In line with these findings, Agustin and Muthi (2024) found that the PjBL learning model was effective in enhancing reading skills among elementary school students. Furthermore, Perayani and Rasna (2022) showed that the implementation of a podcast-based PjBL model was able to improve students' listening skills.

Several studies have also explored the use of technology-based media in listening instruction and reported positive impacts on students' learning outcomes. The use of podcast-based media (Ilana et al., 2021), interactive multimedia video (Juannita & Mahyuddin, 2022), and audio-visual media (Wiranty, 2019) has been shown to improve students' listening abilities. In addition, technology integration in language learning more broadly has been found to enhance learning effectiveness and overall language skills (Lee et al., 2022). However, these studies generally

emphasize the use of technology as a learning medium rather than as a tool integrated into a specific learning model (Gligorea et al., 2023; Shi, 2025).

Furthermore, research integrating Project Based Learning with artificial intelligence in language learning remains limited, particularly in the context of listening instruction at the higher education level (Idawati & Neyarasmi, 2025; Luckyardi et al., 2024). Existing studies have not sufficiently examined how AI tools can be practically incorporated into PjBL activities to support listening skill development. Therefore, further investigation is needed to explore how the integration of AI tools within a PjBL framework can provide a more effective approach to improving students' listening skills (Amiruddin et al., 2025).

Based on these conditions, this study integrates AI tools into the Project Based Learning model to support listening instruction for Indonesian Language Education students. The use of speech-to-text tools and AI-based audio generators is intended to facilitate access to listening materials and support students in analyzing their listening performance during project activities.

Therefore, this study aims to examine the effectiveness of the Project Based Learning (PjBL) model assisted by artificial intelligence in improving the listening skills of Indonesian Language Education students. Specifically, this study seeks to compare listening learning outcomes between students taught using the AI-assisted PjBL model and those taught using conventional learning methods.

Based on these objectives, the research hypothesis is formulated as follows: there is a significant difference in the listening skills of Indonesian Language Education students between those who are taught using the Project Based Learning model assisted by artificial intelligence and those who are taught using conventional learning methods. The AI-assisted Project Based Learning model is hypothesized to be more effective in improving students' listening skills.

METHODS

This study employed a quantitative approach using a quasi-experimental design, specifically a non-equivalent control group design. This design involves two groups an experimental group and a control group without full randomization of participants (Reichardt, 2019). It was selected to examine the effectiveness of the Project Based Learning (PjBL) model assisted by artificial intelligence compared to conventional instruction in improving the listening skills of Indonesian Language Education students.

The object of this study is listening skills learning for Indonesian Language Education students. The research focuses on differences in listening skill outcomes between students who participate in learning using the Project Based Learning model assisted by artificial intelligence and those who participate in conventional learning. The independent variable in this study is the Project Based Learning (PjBL) model assisted by artificial intelligence, defined as project-based learning that emphasizes active student involvement through collaborative and contextual activities supported by AI tools for providing listening materials and facilitating listening analysis. The dependent variable is students' listening skills, defined as the ability to understand, interpret, and analyze spoken information, measured

through listening tests administered before and after the treatment.

The research was conducted in the Indonesian Language and Literature Education Study Program, Universitas Negeri Semarang, during the even semester of the academic year. The population consisted of all students in the program, while the sample was selected using purposive sampling, resulting in two classes with relatively equivalent academic characteristics. The experimental class consisted of 23 students who received instruction using the AI-assisted PjBL model, while the control class consisted of 34 students who received conventional listening instruction.

In the experimental class, the implementation of the AI-assisted Project Based Learning (PjBL) model was carried out over several instructional meetings during the treatment period. Each meeting followed a structured sequence of PjBL stages, including project planning, listening exploration, project development, and project presentation.

During the project planning stage, students were organized into small groups and introduced to project topics related to listening materials. The lecturer provided guidance on the objectives of the project and the expected outcomes. In the listening exploration stage, students engaged in listening activities supported by AI tools. Speech-to-text applications were used to transcribe audio materials and students' listening outputs, enabling them to review and analyze their comprehension more systematically. In addition, AI-based audio generators were used to provide varied and context-based listening materials aligned with the project topics.

In the project development stage, students worked collaboratively to analyze listening content, identify key information, and organize their findings into project outputs. The use of AI tools in this stage supported students in verifying their understanding of spoken texts and refining their analysis. Finally, in the project presentation stage, each group presented their project results, followed by feedback and discussion facilitated by the lecturer.

The learning procedures in the experimental class emphasized active student participation, collaborative learning, and the integration of AI tools as supporting media throughout the learning process. In contrast, the control class followed conventional listening instruction conducted over the same duration, which primarily consisted of lecturer explanation, individual listening exercises, and question-answer sessions without the use of AI tools or project-based activities. This distinction highlights that the main difference between the two groups lies in the integration of structured project-based learning activities and the use of AI tools in the experimental class..

The main data source in this study was students as research subjects. Research data were obtained through test and non-test instruments. The test instrument consisted of a listening skills test administered at the pretest and posttest stages, while the non-test instruments included observation sheets and documentation used to support quantitative data and describe the learning process during the study.

The listening test was developed based on key indicators of listening skills, including the ability to understand main ideas, identify specific information, interpret meaning, and analyze spoken texts. The instrument was designed in accordance with the course learning objectives. To ensure content validity, the test was reviewed by experts in Indonesian language education and language

assessment. Revisions were made based on expert feedback to improve the clarity and relevance of the items. A limited pilot test was also conducted to ensure the suitability of the instrument for students' level. The reliability of the test was examined using internal consistency measures, indicating that the instrument was sufficiently reliable for use in this study.

The observation sheets were developed to capture students' participation and engagement during the learning process, including involvement in group discussions, participation in listening activities, and the use of AI tools. The instrument was reviewed to ensure its alignment with the research objectives.

Data collection was conducted in three stages: administering the pretest, implementing the learning treatment in each group, and administering the posttest.

The collected data were analyzed using descriptive and inferential statistics. Descriptive statistics were used to determine the mean score, maximum score, minimum score, and percentage of student learning mastery. The mean score was calculated using the following formula:

$$\bar{X} = \frac{\sum X}{N}$$

where \bar{X} represents the mean score, $\sum X$ is the total score obtained by students, and N is the number of subjects.

Inferential statistical analysis included tests of normality and homogeneity as prerequisites, paired sample t-tests to examine differences between pretest and posttest scores within each group, and independent sample t-tests to compare posttest results between the experimental and control groups. The effectiveness of improvement in listening skills was further analyzed using the N-gain test, calculated as follows:

$$N - gain = \frac{Posttest\ score - Pretest\ score}{Maximum\ score - Pretest\ score}$$

The results of the N-gain calculation were then interpreted based on the following criteria: $N-gain \geq 0.70$ was categorized as high; $0.30 \leq N-gain < 0.70$ was categorized as moderate; and $N-gain < 0.30$ was categorized as low. All statistical tests in this study were conducted at a significance level of 0.05.

RESULTS & DISCUSSION

Results

This study aims to examine the effectiveness of implementing the Project Based Learning (PjBL) method assisted by artificial intelligence (AI) in improving students' listening skills. The study involved two groups of students, namely a control class consisting of 34 participants and an experimental class consisting of 23 participants. Data collection was conducted in one learning cycle using pretest and posttest measurements.

Table 1. Pretest Results of the Control Class

No.	Source of Variation	Control Class
1.	N	34
2.	Mean	75
3.	Maximum	89
4.	Minimum	55
5.	Total of students who achieved mastery	20
6.	%Percentage of mastery	59%

Based on the pretest scores presented in the table above, a total of 34 students participated in the initial ability test or pretest. The results show that the mean or class average score was 75. Therefore, it can be concluded that the listening instruction in the control class had reached the minimum mastery criterion (KKM) set at 75, but had not yet achieved optimal results. Based on these results, 20 students obtained scores greater than 75 with the highest score of 89, while 14 students did not meet the minimum mastery criterion, with the lowest score being 55.

After the listening instruction was conducted, students were given a posttest to determine the final learning outcomes after the instructional process.

Table 2. Posttest Results of the Control Class

No.	Source of Variation	Control Class
1.	N	34
2.	Mean	81
3.	Maximum	96
4.	Minimum	60
5.	Total of students who achieved mastery	27
6.	% Percentage of mastery	79%

Based on the data obtained from the posttest results in the control class, there was an increase in the mean score achieved by students, which rose to 81, with the Minimum Mastery Criterion (KKM) set at 75. The number of students who achieved mastery also increased to 27 students, with the highest score of 96, while 7 students had not yet met the minimum mastery criterion, with the lowest score being 60.

Table 3. Pretest Results of the Experimental Class

No.	Source of Variation	Experimental Class
1.	N	23
2.	Mean	78
3.	Maximum	87
4.	Minimum	67
5.	Total of students who achieved mastery	19
6.	% Percentage of mastery	83%

Based on the results of the initial test in the experimental class, 23 students participated in the pretest. Of these students, 4 did not meet the minimum mastery criterion, with the lowest score being 67, while 19 students achieved the minimum mastery criterion, with the highest score being 87. It can be concluded that before the implementation of the AI-assisted Project Based Learning (PjBL) model, the experimental class had not yet demonstrated optimal listening comprehension. However, this condition was expected to improve through the application of the AI-assisted PjBL learning model in the listening instruction.

Table 4. Posttest Results of the Experimental Class

No.	Sumber Variasi	Kelas Eksperimen
1.	N	23
2.	Mean	87
3.	Maximum	98
4.	Minimum	78
5.	Total of students who achieved mastery	23
6.	% Percentage of mastery	100%

After the implementation of the AI-assisted Project Based Learning (PjBL) model in the experimental class, an increase was observed in the students' mean score, which reached 87, with the Minimum Mastery Criterion (KKM) set at 75. The number of students who achieved mastery also increased to 23 students, with the highest score of 98 and the lowest score of 78. Thus, all students in the experimental class achieved the minimum mastery criterion.

To ensure the validity of the data, a normality test was conducted using the Kolmogorov-Smirnov test.

Table 5. Results of the Normality Test

	Tests of Normality					
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest Experimental	.133	23	.200*	.968	23	.645
Posttest Experimental	.162	23	.120	.904	23	.031
Pretest Control	.138	34	.200*	.970	23	.700
Posttest Control	.131	34	.200*	.968	23	.632

Based on the results of the normality test, the pretest scores of the control class and the experimental class showed significance values greater than 0.05, namely 0.200 for the control class and 0.120 for the experimental class. Likewise, the posttest scores of both the control and experimental classes showed significance values greater than 0.05, namely 0.200 for the control class and 0.200 for the experimental class. Therefore, it can be concluded that the pretest and posttest data in listening instruction for both the control and experimental classes were normally distributed.

In addition, a homogeneity test using Levene's Test, as presented in the Test of Homogeneity of Variances table, showed significance values of 0.203 and 0.119. Based on these results, it can be concluded that the pretest and posttest data obtained from the control and experimental classes were homogeneous, as the significance values in the Test of Homogeneity of Variances were greater than 0.05.

Table 6. Results of the Homogeneity Test

Tests of Homogeneity of Variances					
		Levene Statistic	df1	df2	Sig.
Pretest results	(Based on Mean)	1.657	1	55	.203
Posttest results	(Based on Mean)	2.509	1	55	.119

After it was confirmed that the data were normally distributed and homogeneous, further testing was conducted to determine the differences between the initial test (pretest) and the final test (posttest) results in the control class in

listening instruction.

Table 7. Results of the Paired Sample t-Test for the Control Class

		Paired Samples Test								
		Paired Differences						t	f	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
					Lower	Upper				
Pair 1	PRETEST1 - POSTEST1	-5.206	3.273	.561	-6.348	-4.064	-9.274	33	.000	

In the control class, the results of the t-test using the paired sample t-test showed a significance value of 0.000, which is less than 0.05. Thus, the pretest and posttest scores of the control class demonstrated a statistically significant difference in mean scores before and after the treatment.

Table 8. Results of the Paired Sample t-Test for the Experimental Class

		Paired Samples Test								
		Paired Differences						t	f	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
					Lower	Upper				
Pair 1	PRETEST2 - POSTEST2	-9.196	4.525	.943	-	-7.239	-9.747	22	.000	
				11.152						

Similarly, in the experimental class, the results of the t-test using the paired sample t-test showed a significance value of 0.000, which is less than 0.05. Therefore, the pretest and posttest scores of the experimental class showed a statistically significant difference in mean scores before and after the treatment.

Furthermore, an independent sample t-test was conducted to compare the posttest results between the two groups.

Table 9. Results of the Independent Sample t-Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F.	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Hasil posttest	Equal variances assumed	2.509	.119	-	55	.002	-6.462	1.986	-10.441	-2.483
	Equal variances not assumed			3.25	4	.001	-6.462	1.846	-10.161	-2.762

Based on the results of the comparison of posttest mean scores between the control class and the experimental class, the obtained significance value (2-tailed) was 0.002 (< 0.05). This indicates that there is a significant difference in listening

learning outcomes between the two classes. Therefore, H_0 is rejected and H_a is accepted, meaning that the use of different learning models has a significant effect on students' learning outcomes.

To determine which learning model is more effective, an analysis using the N-gain test was conducted. The results of the N-gain test in the control class showed an increase in the mean score from 75 to 81, with an N-gain score of 0.21. Based on the gain interpretation criteria, this value falls into the low category, indicating that learning in the control class was less effective. Meanwhile, in the experimental class using the AI-assisted Project Based Learning (PjBL) model, the mean score increased from 80 to 87, with an N-gain score of 0.42. This value falls into the medium category, indicating that the implementation of AI in listening instruction is effective. Therefore, it can be concluded that AI-assisted Project Based Learning is more effective than conventional learning methods in improving students' listening skills.

Discussion

The findings of this study indicate that both conventional instruction and AI-assisted Project-Based Learning (PjBL) contributed to improvements in students' listening skills; however, the extent of improvement differed significantly. The relatively limited gains observed in the control group suggest that conventional approaches tend to support only incremental development in listening comprehension. In contrast, the experimental group demonstrated more substantial improvement, indicating that the integration of AI within a PjBL framework provides a more effective approach to enhancing listening ability.

One possible explanation for this difference lies in the nature of learning activities embedded in the PjBL approach. Through project-based tasks, students are required to actively engage with listening materials, which may encourage deeper processing of spoken input. This active engagement allows learners to revisit, interpret, and analyze auditory information more meaningfully, contributing to improved listening outcomes.

The role of Artificial Intelligence (AI) in this study can be understood as a supportive learning tool that enhances access to listening input and facilitates comprehension. The use of speech-to-text tools and AI-generated audio materials enables students to review listening content and verify their understanding. This finding is consistent with previous research demonstrating that AI-based language learning applications can significantly improve listening skills by providing repeated exposure and interactive practice opportunities (Loebis, 2025). Similarly, the use of AI technologies such as text-to-speech and chatbot systems has been shown to support listening competence by allowing learners to access flexible and varied listening input (Akmal et al., 2024; Zhou et al., 2025).

In addition, AI appears to support the development of listening strategies, particularly in helping learners monitor and evaluate their comprehension. Rui and Baki (2026) found that AI-assisted learning environments can enhance learners' metacognitive awareness in listening by enabling them to reflect on their understanding and identify areas for improvement. In the context of this study, the availability of transcription tools and AI-generated materials may have facilitated

similar processes, allowing students to engage more actively in evaluating their listening performance.

Furthermore, the integration of AI within the PjBL framework may enhance the effectiveness of listening instruction by providing structured support during project activities. Previous studies suggest that AI in project-based learning environments can contribute to language learning by supporting access to materials and facilitating learning processes, rather than replacing pedagogical design (Manoocherzadeh et al., 2025; Arqam, & Asrifan, 2024). This indicates that the effectiveness observed in this study is likely influenced by the combination of active learning strategies and appropriate technological support.

It is important to emphasize that the conclusions of this study are limited to listening skills as measured through pretest and posttest scores. Although project-based learning involves interactive and collaborative elements, this study did not directly measure outcomes beyond listening comprehension. Therefore, interpretations should remain focused on the observed improvement in listening ability.

Overall, the findings suggest that AI-assisted PjBL provides a more effective instructional approach than conventional methods for improving listening skills. The combination of active engagement through project-based learning and technological support through AI tools creates a learning environment that facilitates deeper processing of listening materials. Future research is recommended to explore the use of more advanced AI tools and to examine their impact on listening development across different learning contexts.

CONCLUSION

This study demonstrates that the integration of Artificial Intelligence (AI) within the Project-Based Learning (PjBL) model is more effective than conventional instruction in improving the listening skills of Indonesian Language Education students. The experimental group showed higher learning outcomes, with a mean posttest score of 87 compared to 81 in the control group, and a moderate N-gain (0.42) compared to a low N-gain (0.21) in the control class. In addition, the independent sample t-test indicated a significant difference between the two groups ($p < 0.05$).

These findings suggest that the combination of project-based learning activities and AI support can enhance listening comprehension more effectively than conventional approaches. The role of AI in this study is primarily as a supporting tool that facilitates access to listening materials and enables students to review and analyze spoken input more systematically. However, this study is limited to the measurement of listening skills based on pretest and posttest results. Therefore, the conclusions are confined to listening comprehension and do not extend to other language skills or broader learning outcomes. Based on these findings, AI-assisted PjBL can be considered an alternative approach for listening instruction in higher education. Future research is recommended to explore the use of different AI tools and to examine their impact on listening development in broader contexts.

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