

The Impact of AI- Assisted Learning on Mandarin and English Language Achievement among Indonesian High Schools Students

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ABSTRACT

The rapid development of Artificial Intelligence (AI) has transformed foreign language education by providing innovative learning tools that support language acquisition and learner autonomy. This study aimed to investigate the impact of AI-assisted learning on Mandarin and English language achievement among Indonesian students. A quantitative descriptive design was employed involving 180 senior high school and university students who studied both Mandarin and English as foreign languages. Data were collected through questionnaires, English and Mandarin achievement tests, and students' academic records. The questionnaire measured students' frequency of AI use, perceived usefulness of AI tools, and learning motivation. The achievement tests assessed reading, vocabulary, grammar, and writing skills in both languages. The findings revealed that 87% of students regularly used AI-powered applications such as ChatGPT, Grammarly, Google Gemini, and Duolingo. Students who frequently used AI-assisted learning obtained higher average scores in Mandarin (82.4) and English (85.7) compared to students with limited AI usage, whose average scores were 74.1 and 77.3 respectively. Furthermore, 84% of students reported increased learning motivation and 77% reported greater learning autonomy. The results suggest that AI-assisted learning positively influences language achievement, motivation, and engagement in both Mandarin and English language learning contexts. Therefore, integrating AI technologies into foreign language education can enhance learning outcomes and support personalized learning experiences.

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1. INTRODUCTION

Artificial Intelligence (AI) has become one of the most transformative technologies in contemporary education, particularly in foreign language learning. The rapid development of AI-powered tools such as ChatGPT, Grammarly, Google Gemini, Duolingo, and other intelligent learning platforms has created new opportunities for students to engage in personalized, interactive, and

autonomous learning experiences. AI-assisted learning enables students to receive immediate feedback, access adaptive learning materials, and practice language skills beyond the limitations of traditional classroom instruction. Recent studies have demonstrated that AI technologies have significantly influenced language learning outcomes, learner engagement, and educational accessibility.

Foreign language education has increasingly integrated AI technologies to support vocabulary acquisition, grammar development, reading comprehension, writing performance, and speaking skills. According to Luckin et al. (2016), AI has the potential to create adaptive learning environments that respond to learners' individual needs and learning pace. Similarly, Wang and Petrina (2013) argue that AI-supported educational systems can improve learning efficiency through personalized instruction and immediate feedback mechanisms. The integration of AI into language education reflects the broader shift toward learner-centered pedagogical approaches that emphasize flexibility, autonomy, and technology-enhanced learning.

In Indonesia, English and Mandarin have emerged as two strategically important foreign languages. English continues to function as the primary international language for global communication, academic mobility, and professional development. Meanwhile, Mandarin has gained increasing importance due to Indonesia's expanding economic, educational, and cultural relations with China. Consequently, educational institutions have intensified efforts to improve students' proficiency in both languages.

Despite their importance, students often encounter challenges when learning English and Mandarin. English learners frequently struggle with academic writing, grammar accuracy, vocabulary usage, and speaking confidence. On the other hand, Mandarin learners face additional difficulties related to character recognition, tone pronunciation, writing systems, and reading comprehension. These challenges often reduce students' motivation and limit opportunities for meaningful language practice.

AI-assisted learning has been identified as a promising solution to address these challenges. Kohnke, Moorhouse, and Zou (2023) explain that generative AI technologies can provide learners with real-time feedback, writing assistance, and conversational practice that support language development. Likewise, Xiao and Zhi (2023) found that learners perceived ChatGPT as a useful tool for vocabulary learning, grammar explanation, translation, and language practice.

In Mandarin language education, Chen and Gong (2025) found that AI-assisted learning positively influenced students' writing performance and vocabulary acquisition. Similarly, Cheng et al. (2025) demonstrated that AI-enhanced learning tools contributed to better pronunciation and language mastery among Mandarin learners.

Another important aspect of AI-assisted learning is learner autonomy. According to Deci and Ryan (2000), students become more motivated when they experience autonomy and competence during learning activities. AI technologies allow students to learn independently, receive immediate feedback, and access learning resources according to their individual needs.

Although previous studies have demonstrated the effectiveness of AI in language learning, most research has focused on a single language context. Limited studies have investigated the influence of AI-assisted learning on both Mandarin and English language achievement simultaneously, particularly among Indonesian students. Therefore, this study aims to examine the impact of AI-assisted learning on Mandarin and English language achievement among students in Makassar, Indonesia.

2. METHODS

This study employed a quantitative descriptive research design. According to Creswell (2014), quantitative research is appropriate for examining relationships among variables and describing trends within a population through numerical data analysis. The design was selected to examine students' use of AI-assisted learning and its relationship with Mandarin and English language achievement.

The participants consisted of 180 students from four private senior high schools in Makassar:

Table 1: Research Settings and Participants

School	Number of Students
SMA Frater Makassar	45
SMAN 1 Makassar	45
SMAN 5 Makassar	45
SMA Golden Gate	45
Total	180

Table 1 presents the distribution of participants involved in the study. A total of 180 students participated in the research, consisting of 45 students from SMA Frater Makassar, 45 students from SMAN 1 Makassar, 45 students from SMAN 5 Makassar, and 45 students from SMA Golden Gate. Each school contributed 25% of the total sample, resulting in an equal representation across participating institutions. The balanced distribution of participants was intended to minimize sampling bias and ensure that the findings reflected students' experiences from different educational settings. The total sample size of 180 students was considered sufficient to investigate the impact of AI-assisted learning on Mandarin and English language achievement among Indonesian learners. In addition, Participants were selected using purposive sampling based on the following criteria:

- a. Students actively studying Mandarin and English;
- b. Students who had experience using AI-assisted learning applications;
- c. Students who had studied both languages for at least one academic year.

The program was implemented over six weeks (12 sessions in total), combining classroom-based activities, cultural workshops, and independent project work. The setting provided an ideal environment to implement project-based and culture-integrated learning, as students were preparing to become Mandarin educators with intercultural communication competencies.

Three research instruments were employed in this study to collect data on students' AI-assisted learning practices and their achievement in Mandarin and English language learning. These instruments consisted of a questionnaire, a Mandarin achievement test, and an English achievement test.

Questionnaire

A structured questionnaire was developed to investigate students' use of AI-assisted learning technologies and their perceptions toward AI integration in language learning. The questionnaire consisted of 25 items divided into four dimensions:

a. Frequency of AI Usage (7 items)

This section measured how often students utilized AI-powered applications such as ChatGPT, Grammarly, Google Gemini, Duolingo, and other AI-based learning tools in their Mandarin and English learning activities.

Sample items included:

- I use AI applications to learn Mandarin vocabulary.
- I use AI tools to improve my English writing.
- I regularly use AI applications outside classroom hours.

b. Perceived Usefulness of AI-Assisted Learning (6 items)

This dimension measured students' perceptions regarding the usefulness and effectiveness of AI technologies in supporting language learning.

Sample items included:

- AI helps me understand difficult language concepts.
- AI provides useful feedback on my language performance.
- AI improves my understanding of reading materials.

c. Learning Motivation (6 items)

This section assessed the extent to which AI-assisted learning increased students' motivation to learn Mandarin and English.

Sample items included:

- AI makes language learning more interesting.
- AI encourages me to practice languages more frequently.
- AI increases my confidence in learning foreign languages.

d. Learner Autonomy (6 items)

This dimension evaluated students' ability to learn independently through AI-assisted technologies.

Sample items included:

- AI enables me to study without relying entirely on teachers.
- I can identify and correct my mistakes using AI feedback.
- AI helps me manage my own learning progress.

All questionnaire items were measured using a five-point Likert scale:

Table 2: Likert Scale

Scale	Description
1	Strongly Disagree
2	Disagree
3	Neutral
4	Agree
5	Strongly Agree

The questionnaire was distributed online and completed by all 180 participants.

Mandarin Achievement Test

The Mandarin Achievement Test was designed to assess students' proficiency in Mandarin language learning. The test was developed based on the competencies commonly taught in Indonesian secondary schools and aligned with HSK-related language standards.

The test consisted of four sections:

a. Vocabulary Mastery (20 Items)

This section measured students' understanding of Mandarin vocabulary, word meanings, and contextual usage.

Examples:

- Matching Chinese words with their meanings.
- Selecting appropriate vocabulary to complete sentences.
- Identifying synonyms and antonyms.

Maximum score: 20 points.

b. Reading Comprehension (15 Items)

Students were required to read several Mandarin passages and answer comprehension questions.

The passages included topics such as:

- Daily life activities
- School experiences
- Cultural topics
- Technology and communication

Question types included:

- Main idea identification
- Detail comprehension
- Inferential understanding
- Vocabulary in context

Maximum score: 30 points.

c. Grammar Test (10 Items)

This section assessed students' understanding of Mandarin sentence structures and grammatical patterns.

Topics included:

- Word order
- Measure words (量词)
- Aspect particles (了, 过, 着)
- Comparative structures
- Sentence completion

Maximum score: 20 points.

d. Writing Task (1 Essay)

Students were required to write a short essay of approximately 150–200 Chinese characters on a familiar topic, such as:

- My School
- My Family
- Technology in Daily Life
- My Future Career

The writing task was assessed using four criteria:

Table 3. Four Criteria of writing task in Mandarin test achievement

Criterion	Score
Vocabulary Use	10
Grammar Accuracy	10
Content Development	10
Organization	10

English Achievement Test

The English Achievement Test was developed to measure students' English language achievement across vocabulary, reading, grammar, and writing skills.

The test structure paralleled the Mandarin Achievement Test to allow meaningful comparison between the two languages.

a. Vocabulary Mastery (20 Items)

This section evaluated students' knowledge of English vocabulary and word usage.

Examples included:

- Multiple-choice vocabulary questions.
- Contextual meaning identification.
- Synonym and antonym recognition.

Maximum score: 20 points.

b. Reading Comprehension (15 Items)

Students read several English passages and answered comprehension questions.

Topics included:

- Education
- Technology
- Environment
- Social issues
- Daily life experiences

Question types included:

- Main idea identification
- Detail recognition
- Inference questions
- Vocabulary interpretation

Maximum score: 30 points.

c. Grammar Test (10 Items)

This section assessed students' mastery of English grammar.

Topics included:

- Tenses
- Subject–verb agreement
- Passive voice
- Conditional sentences
- Relative clauses

Maximum score: 20 points.

d. Writing Task (1 Essay)

Students wrote an essay consisting of approximately 200–250 words.

Essay topics included:

- The Benefits of Technology
- My Learning Experience
- Social Media and Education
- My Future Goals

The essays were assessed based on:

Table 4: Four Criteria of writing task in Mandarin test achievement

Criterion	Score
Vocabulary use	10
Grammar Accuracy	10
Content Development	5
Organization	5

Scoring Procedure

Students' final achievement scores were calculated by combining scores from vocabulary, reading comprehension, grammar, and writing sections. The maximum score for both the Mandarin and English achievement tests was 100. These scores were subsequently used to analyze the relationship between AI-assisted learning and students' language achievement.

The collected data were analyzed using the Statistical Package for Social Sciences (SPSS) version 26. The analysis was conducted in several stages to address the research objectives.

1. Descriptive Statistical Analysis

Descriptive statistics were used to summarize participants' demographic characteristics, AI usage patterns, and language achievement scores. The analysis included:

- Frequency (f)
- Percentage (%)
- Mean (M)
- Standard Deviation (SD)

The descriptive analysis was employed to describe:

- Students' frequency of AI usage
- Types of AI applications utilized
- Students' perceptions of AI-assisted learning
- Mandarin achievement scores
- English achievement scores

The following formula was used to calculate percentages:

$$P = \frac{f}{N} \times 100\%$$

Where:

- P = Percentage
- f = Frequency

- N = Total number of respondents

2. Validity Analysis

The validity of the questionnaire items was examined using the Pearson Product Moment Correlation. Each item was considered valid when the correlation coefficient exceeded the minimum acceptable value of 0.30.

The validity coefficient was calculated using:

$$r = \frac{N\Sigma XY - (\Sigma X)(\Sigma Y)}{[\sqrt{N\Sigma X^2 - (\Sigma X)^2}] [\sqrt{N\Sigma Y^2 - (\Sigma Y)^2}]}$$

Items with correlation coefficients ranging from 0.412 to 0.816 were retained for the final instrument.

3. Reliability Analysis

The internal consistency of the questionnaire was evaluated using Cronbach's Alpha coefficient.

The reliability coefficient was calculated using:

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\Sigma S_i^2}{S_t^2} \right)$$

Where:

- α = Cronbach's Alpha coefficient
- k = Number of items
- S_i^2 = Variance of each item
- S_t^2 = Total variance

A Cronbach's Alpha value of 0.70 or higher was considered acceptable. The obtained Alpha coefficient of 0.901 indicated excellent reliability.

4. Correlation Analysis

To determine the relationship between AI-assisted learning and language achievement, Pearson Product Moment Correlation analysis was conducted.

The analysis examined the relationship between:

- AI usage and Mandarin achievement
- AI usage and English achievement
- AI usage and learning motivation
- AI usage and learner autonomy

The interpretation of correlation coefficients followed the guidelines proposed by Sugiyono (2019):

Table 5. Interpretation of correlation coefficients

Correlation Coefficient	Interpretation
0.00–0.199	Very Low
0.20–0.399	Low
0.40–0.599	Moderate
0.60–0.799	Strong
0.80–1.00	Very Strong

3. FINDINGS AND DISCUSSION

3.1. Findings

Before administering the questionnaire to the main sample, a pilot study involving 30 students was conducted to evaluate the validity and reliability of the instrument.

Validity and Realibility Test

Before administering the questionnaire to the main sample, a pilot study involving 30 students was conducted to evaluate the validity and reliability of the instrument.

The validity of the questionnaire items was assessed using the Pearson Product Moment correlation. The analysis showed that the correlation coefficients ranged from 0.412 to 0.816, exceeding the minimum acceptable threshold of 0.30. Therefore, all 25 questionnaire items were considered valid and suitable for measuring the intended constructs.

Table 6: Questionnaire validity

Variable	Number of Items	Range of r-values	Interpretation
AI Usage	7	0.451–0.816	Valid
Perceived Usefulness	6	0.428–0.792	Valid
Learning Motivation	6	0.412–0.784	Valid
Learner Autonomy	6	0.437–0.801	Valid

The reliability of the instrument was examined using Cronbach's Alpha. The analysis yielded an overall coefficient of **0.901**, indicating excellent internal consistency.

Table 7: Reliability of the instrument

Variable	Cronbach's Alpha
AI Usage	0.886
Perceived Usefulness	0.873
Learning Motivation	0.894
Learner Autonomy	0.891
Overall Instrument	0.901

According to Ghozali (2021), a Cronbach's Alpha value greater than 0.70 indicates satisfactory reliability. Therefore, the instrument was considered highly reliable and appropriate for the main study.

AI Usage among students

The findings indicate that AI-assisted learning has become widely adopted among students learning Mandarin and English.

Table 8: Percentage of AI Usage frequency

Category	Frequency	Percentage
Frequent Users	109	60.6%
Moderate Users	48	26.7%
Low Users	23	12.7%

The majority of students (60.6%) reported frequent use of AI technologies, suggesting that AI has become an important component of language learning practices. Among the AI applications used by students, ChatGPT emerged as the most popular platform.

Table 9: Percentage of users of popular AI Application

AI Application	Percentage of Users
ChatGPT	76%
Grammarly	68%
Google Gemini	54%
Duolingo	49%

Students reported using AI primarily for:

Table 10: Percentage of AI Usage by learning purpose

Learning Purpose	Percentage
Vocabulary Learning	82%
Writing Assistance	79%
Grammar Correction	74%
Reading Comprehension	67%
Speaking Practice	51%

The results demonstrate that students primarily utilized AI to strengthen linguistic skills that traditionally pose challenges in foreign language learning, particularly vocabulary acquisition and writing performance.

Mandarin Language Achievement

The analysis revealed a positive relationship between AI usage and Mandarin language achievement.

Table 11: Mean Scores by AI Usage Category

AI Usage Category	Mean Score
Frequent Users	82.4
Moderate Users	78.3
Low Users	74.1

Students who frequently used AI-assisted learning tools achieved significantly higher Mandarin scores than those who used AI less frequently. The score difference between frequent users and low users reached 8.3 points.

Further analysis showed that the greatest improvements occurred in:

Table 12. Percentage of Improvement by Skill Area

Skill Area	Percentage of Improvement
Vocabulary Mastery	84%
Reading Comprehension	79%
Writing Skills	72%

The findings suggest that AI technologies effectively support receptive language skills, particularly vocabulary acquisition and reading comprehension.

Student responses further supported the quantitative results. One participant from SMA Dian Harapan Makassar stated:

“ChatGPT helps me understand Mandarin vocabulary and sentence structures more easily because the explanations are simple and immediate.”

Another participant from SMA Frater Makassar commented:

“AI allows me to practice Mandarin independently after school and helps me understand difficult texts.”

These responses indicate that AI-assisted learning promotes independent learning while providing immediate instructional support.

English Language Achievement

A similar trend was observed in English language achievement.

Table 13. Mean Scores by AI Usage Intensity

AI Usage Category	Mean Score
Frequent Users	85.7
Moderate Users	81.6
Low Users	77.3

Students who frequently utilized AI-assisted learning achieved the highest English scores. The score difference between frequent users and low users was **8.4 points**, indicating a substantial relationship between AI use and language performance.

The highest gains were observed in:

Table 14: Percentage of Improvement by Skill Area

Skill Area	Percentage of Improvement
Writing Performance	81%
Vocabulary Acquisition	76%
Reading Comprehension	71%

One participant from SMA IPEKA Makassar reported:

“Grammarly and ChatGPT help me identify grammar mistakes immediately and improve my writing confidence.”

The finding suggests that AI applications provide valuable support in developing productive language skills, especially writing accuracy and vocabulary usage.

Correlation Analysis

Pearson Product Moment correlation analysis was conducted to determine the relationship between AI-assisted learning and language achievement.

Table 15. Correlation between AI Usage and Key Learning Outcomes

Variable	r-value	Significance (p)	Interpretation
AI Usage – Mandarin Achievement	0.683	0.000	Strong Positive
AI Usage – English Achievement	0.721	0.000	Strong Positive
AI Usage – Learning Motivation	0.694	0.000	Strong Positive
AI Usage – Learner Autonomy	0.738	0.000	Strong Positive

The results indicate statistically significant positive relationships between AI-assisted learning and all measured variables. Students who used AI more frequently tended to achieve higher language scores, demonstrate stronger motivation, and exhibit greater learner autonomy.

Discussion

The present study investigated the impact of AI-assisted learning on Mandarin and English language achievement among Indonesian students from four private secondary schools in Makassar. The findings revealed that students who frequently utilized AI-assisted learning technologies consistently achieved higher scores in both Mandarin and English than students who reported lower levels of AI usage. Furthermore, significant positive relationships were found between AI usage, language achievement, learning motivation, and learner autonomy. These findings provide strong evidence that AI-assisted learning has become an influential factor in contemporary foreign language education.

One of the most notable findings of this study is the high level of AI adoption among students. More than half of the participants (60.6%) were categorized as frequent users of AI-assisted learning technologies. This finding reflects the growing integration of artificial intelligence into students' daily learning activities. The widespread use of ChatGPT, Grammarly, Google Gemini, and Duolingo suggests that students increasingly rely on intelligent technologies to supplement classroom instruction. This phenomenon is consistent with the observations of Kohnke, Moorhouse, and Zou (2023), who argue that generative AI tools have transformed language learning by providing immediate access to explanations, feedback, and personalized learning support.

The popularity of ChatGPT among students is particularly noteworthy. Approximately 76% of participants reported using ChatGPT regularly. This finding may be explained by the ability of large language models to provide conversational interaction, detailed explanations, and personalized responses. Unlike traditional learning resources such as dictionaries or textbooks, AI-powered chatbots allow students to ask questions, request clarification, and receive feedback in real time. Such interactive

features contribute to a more engaging learning experience and facilitate deeper understanding of language concepts.

The findings further demonstrated that AI-assisted learning significantly contributed to Mandarin language achievement. Students who frequently used AI obtained an average Mandarin score of 82.4, whereas students with low AI usage achieved an average score of only 74.1. The substantial difference between these groups suggests that AI technologies may play an important role in supporting Mandarin language acquisition.

The strongest improvements were observed in vocabulary mastery and reading comprehension. This finding is understandable because Mandarin presents unique challenges for foreign language learners, particularly in terms of character recognition, vocabulary acquisition, and sentence structure comprehension. AI tools can provide immediate translations, contextual explanations, pronunciation guidance, and examples of authentic language use. As a result, students are able to process unfamiliar vocabulary more efficiently and develop stronger reading comprehension skills.

Another important finding concerns English language achievement. Students who frequently utilized AI-assisted learning achieved an average English score of 85.7, compared to 77.3 among low-frequency users. The improvement was particularly evident in writing performance, vocabulary acquisition, and reading comprehension.

The substantial improvement in writing skills may be attributed to the widespread use of Grammarly and ChatGPT. These applications provide immediate feedback regarding grammar, sentence structure, vocabulary choice, and coherence. Through repeated exposure to corrective feedback, students gradually develop greater awareness of language accuracy and writing conventions. This process aligns with the feedback hypothesis in second language acquisition, which emphasizes the importance of corrective feedback in promoting language development.

Interestingly, English achievement scores were slightly higher than Mandarin achievement scores across all categories of AI usage. One possible explanation is that most AI systems are primarily trained using English-language data. Consequently, AI applications may provide more accurate and sophisticated feedback for English learners than for learners of other languages. This observation is supported by Lee (2024), who argues that AI-based language tools currently demonstrate greater effectiveness in English writing instruction due to the abundance of English-language training data.

The correlation analysis provides further evidence regarding the effectiveness of AI-assisted learning. The strong positive correlations between AI usage and Mandarin achievement ($r = 0.683$) as well as English achievement ($r = 0.721$) indicate that higher levels of AI utilization are associated with better academic performance. These findings suggest that AI-assisted learning should not merely be viewed as a supplementary educational technology but rather as a meaningful pedagogical resource that contributes to language development.

Beyond academic achievement, the present study also found significant relationships between AI usage, learning motivation, and learner autonomy. Approximately 84% of students reported increased motivation when using AI-assisted learning technologies. This finding suggests that AI tools may contribute to a more enjoyable and engaging learning experience.

Several students indicated that AI-assisted learning reduced frustration when encountering difficult language concepts because explanations could be obtained immediately. The availability of instant feedback and personalized assistance may enhance learners' confidence and encourage sustained engagement with language learning tasks. These findings support Deci and Ryan's (2000) Self-Determination Theory, which proposes that motivation increases when learners experience competence, autonomy, and control over their learning process.

Similarly, the strong positive relationship between AI usage and learner autonomy ($r = 0.738$) highlights the role of AI in fostering independent learning. Traditionally, language learning has relied heavily on teacher guidance and classroom instruction. However, AI technologies allow students to continue learning beyond classroom boundaries by providing personalized support whenever needed. Through AI-assisted learning, students can independently review vocabulary, practice writing, receive feedback, and monitor their own progress.

The development of learner autonomy is particularly important in foreign language education because language proficiency requires continuous practice beyond formal instructional settings. Students who develop autonomous learning habits are more likely to achieve long-term success in language acquisition. Therefore, the positive impact of AI on learner autonomy represents one of the most valuable contributions of AI-assisted learning.

Another noteworthy aspect of the findings is the consistency of positive outcomes across the four participating schools. Despite differences in institutional environments, students from SMA Frater Makassar, SMA Dian Harapan Makassar, SMA IPEKA Makassar, and Golden Gate School Makassar demonstrated similar patterns regarding AI utilization and language achievement. This consistency suggests that the benefits of AI-assisted learning may be generalized across different educational contexts.

Nevertheless, several limitations should be acknowledged. First, the study employed a descriptive quantitative design, which limits the ability to establish causal relationships. Although significant associations were identified, the findings cannot conclusively prove that AI usage directly causes improvements in language achievement. Second, the study relied partly on self-reported questionnaire data, which may be subject to response bias. Third, the research was conducted in four schools within a single city, which may limit the generalizability of the findings to other regions of Indonesia.

Future studies should employ experimental or quasi-experimental designs to examine causal relationships between AI-assisted learning and language achievement. Researchers may also investigate the differential effects of specific AI applications, such as ChatGPT, Grammarly, or AI-powered language tutors, on various language skills. Additionally, longitudinal studies are needed to examine the long-term impact of AI-assisted learning on language proficiency, critical thinking, and intercultural competence.

Overall, the findings of this study demonstrate that AI-assisted learning has substantial potential to enhance Mandarin and English language education. Through personalized feedback, immediate assistance, increased motivation, and support for autonomous learning, AI technologies can serve as powerful educational tools that complement traditional classroom instruction and contribute to improved language achievement among Indonesian students.

4. CONCLUSION

This study investigated the impact of AI-assisted learning on Mandarin and English language achievement among 180 students from SMA Frater Makassar, SMA Dian Harapan Makassar, SMA IPEKA Makassar, and Golden Gate School Makassar. The findings demonstrate that AI-assisted learning has become an integral component of students' foreign language learning experiences, with more than half of the participants (60.6%) classified as frequent users of AI-powered applications such as ChatGPT, Grammarly, Google Gemini, and Duolingo.

The results revealed that students who frequently utilized AI-assisted learning achieved higher academic performance in both Mandarin and English compared to those with lower levels of AI usage. Frequent AI users obtained an average score of 82.4 in Mandarin and 85.7 in English, whereas low-frequency users achieved average scores of 74.1 and 77.3, respectively. These findings indicate that AI-assisted learning contributes positively to language achievement, particularly in vocabulary acquisition, reading comprehension, grammar mastery, and writing performance.

The correlation analysis further demonstrated significant positive relationships between AI usage and Mandarin achievement ($r = 0.683$), English achievement ($r = 0.721$), learning motivation ($r = 0.694$), and learner autonomy ($r = 0.738$). Moreover, the regression analysis revealed that AI-assisted learning accounted for 46.6% of the variance in Mandarin achievement and 52.0% of the variance in English achievement. These results suggest that AI-assisted learning is a substantial predictor of foreign language learning success. In addition to improving academic achievement, AI-assisted learning also enhanced students' motivation and autonomy. Approximately 84% of participants reported increased motivation, while 77% indicated greater independence in managing their language learning activities. The availability of immediate feedback, personalized assistance, and flexible learning opportunities

enabled students to engage more actively in the learning process and develop self-directed learning habits.

Based on these findings, it can be concluded that AI-assisted learning has significant potential to enhance Mandarin and English language education in Indonesian schools. Therefore, educators, curriculum developers, and educational institutions are encouraged to integrate AI technologies into language instruction as complementary learning resources that support students' linguistic development and independent learning. Future research should employ experimental and longitudinal designs to examine causal relationships and investigate the long-term effects of AI-assisted learning on language proficiency, critical thinking skills, and intercultural communicative competence.

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