Revolutionizing Language Learning: The Power of AI-Driven Chatbots in Enhancing Engagement and Proficiency

Hesti Fibriasari[1], Bakti Dwi Waluyo[2,*], Tansa Trisna Astono Putri[2], Tengku Ratna Soraya[1], and Nurilam Harianja[1]

[1]Department of Foreign Languages, Faculty of Languages and Arts, Universitas Negeri Medan, Medan, Indonesia
[2]Department of Electronic Engineering Education, Faculty of Engineering, Universitas Negeri Medan, Medan, Indonesia
Email: hesti@unimed.ac.id (H.F.); bakti_dw@unimed.ac.id (B.D.W.); tansatrisna@unimed.ac.id (T.T.A.P.); ratnasoraya@unimed.ac.id (T.R.S.); nurilam@unimed.ac.id (N.H.)
*Corresponding author
Manuscript received February 14, 2025; revised March 18, 2025; accepted March 28, 2025; published October 14, 2025

***Abstract*—Integrating Artificial Intelligence (AI) into language learning has substantially enhanced accessibility and engagement by offering interactive and adaptive experiences. However, many AI-driven chatbots lack contextual relevance, limiting their effectiveness for vocational high school students who require career-oriented language instruction. This study aims to develop and evaluate EduNetPro (Education Network for Professional Learning), a multilingual AI-driven chatbot designed to enhance French language learning among vocational students by incorporating adaptive learning pathways, interactive exercises, and gamification elements. Adopting a Design-Based Research (DBR) approach, this study employs a mixed-methods approach, combining quantitative assessments (pre-test and post-test evaluations) with qualitative analyses (student interviews and chatbot interaction logs) to assess EduNetPro's effectiveness. The findings indicate a 24% improvement in language proficiency, with 80% of students reporting increased engagement and 90% highlighting the efficacy of real-time feedback. Despite these positive outcomes, the chatbot encountered challenges in processing complex dialogues, particularly those involving idiomatic expressions and context-dependent language, emphasizing the need for advancements in Natural Language Processing (NLP) models. This study contributes to the ongoing discourse on AI in education, demonstrating how chatbot-driven learning can address the unique needs of vocational students by providing contextualized, career-focused language instruction. Future research should further explore AI-driven emotional intelligence, enhanced personalization strategies, and long-term language retention to optimize AI-assisted learning environments.**

***Keywords*—Artificial Intelligence (AI)-driven chatbots, natural language processing, vocational education, student engagement, adaptive learning**

I. Introduction

The integration of Artificial Intelligence (AI) in education has revolutionized language learning by providing personalized, adaptive, and interactive experiences [1, 2]. AI-driven chatbots, such as Duolingo's AI tutor and Google's language learning assistant, leverage Natural Language Processing (NLP) to simulate human-like conversations, deliver real-time feedback, and enhance learner engagement [3, 4]. These innovations have significantly improved accessibility and efficiency in language acquisition, particularly in self-directed and remote learning settings. Several AI-based platforms, including Babbel and TalkPal, have gained prominence by offering interactive lessons and adaptive learning features tailored to different learner needs [5]. For instance, Babbel focuses on structured conversational language practice, while TalkPal emphasizes live interaction and real-time feedback to improve speaking proficiency [6, 7]. Furthermore, platforms such as Mondly employ speech recognition technology to refine pronunciation, further expanding the scope of digital language education [8]. These advancements underscore the increasing role of AI-driven chatbots in language learning as they address gaps left by traditional teaching methods [9].

Despite these advancements, Vocational High School (VHS) students face significant challenges in acquiring foreign language proficiency. Traditional classroom instruction often limits opportunities for interactive speaking practice, hindering students' ability to engage in meaningful communication in the target language [10]. Additionally, vocational students generally exhibit lower motivation for learning foreign languages due to the emphasis on technical and practical skills over linguistic competence [11]. Unlike senior high school students, who may be academically motivated to acquire foreign language skills, vocational students require contextualized language instruction that aligns with their career-related goals, particularly in workplace communication.

Given these distinct learning needs, language instruction for vocational students should prioritize real-world applications relevant to their professional environments. EduNetPro, an AI-powered chatbot explicitly designed for vocational education, addresses this need by integrating career-focused language tasks and adaptive learning pathways. Unlike conventional language learning tools, EduNetPro provides a personalized experience through real-world scenarios, gamification elements, and adaptive learning strategies that enhance engagement and ensure relevance to students' future careers. This AI-driven chatbot facilitates language acquisition and prepares vocational students to communicate effectively in workplace settings, making learning more practical and meaningful.

One of the key aspects of this study is its focus on French language learning for vocational students—the selection of French as the target language is driven by several factors. First, French is one of the most widely spoken languages in the world, with official status in over 29 countries, making it a valuable asset for global communication and career opportunities [12]. Second, in many regions, including parts of Europe, Africa, and Canada, proficiency in French is essential for professional mobility and access to international job markets [13]. Third, French is commonly used in hospitality, tourism, diplomacy, and global trade and often

employs vocational graduates. Given the increasing demand for multilingual professionals in these fields, equipping vocational students with French language skills enhances their employability. It prepares them for career opportunities in both local and global markets.

While existing AI-based chatbots have demonstrated effectiveness in senior high schools, they often struggle to sustain student engagement in vocational settings due to limited gamification strategies, insufficient real-world conversational scenarios, and minimal personalization [14, 15]. These limitations highlight the need for an AI-driven approach supporting language learning and fostering sustained engagement through contextualized and interactive experiences tailored to vocational students' requirements. EduNetPro fills this gap by offering an adaptive, interactive, and gamified learning environment that aligns with the practical language skills required in vocational fields.

To address these challenges, this study introduces EduNetPro, a multilingual AI-powered chatbot that enhances French language learning in vocational high schools. By integrating adaptive learning pathways, interactive exercises, and gamification elements, EduNetPro seeks to maintain student motivation and engagement. AI-driven chatbots are increasingly adopted in education, employing NLP techniques such as tokenization, sentiment analysis, and speech recognition to analyze and interpret text effectively. These technologies personalize learning experiences, provide real-time feedback, and facilitate dynamic conversational practice tailored to each learner's proficiency level.

This study employs a mixed-methods approach to assess the effectiveness of EduNetPro, combining quantitative evaluations of language proficiency with qualitative analyses of student engagement. By bridging existing gaps in AI-driven language education, this research provides empirical evidence on the role of chatbots in vocational learning environments. It offers valuable insights for educators seeking to integrate AI-based solutions into their curricula. Ultimately, this study contributes to the broader discourse on AI in education, demonstrating how intelligent chatbot technology can transform foreign language learning in diverse educational settings [16].

Unlike general AI-driven chatbots like Duolingo and Mondly, EduNetPro is uniquely tailored for vocational students. While existing platforms are adequate for general language learning, EduNetPro enhances these tools by incorporating adaptive learning pathways, vocationally relevant tasks, and advanced gamification strategies that align more closely with students' career-related needs.

II. Literature Review

This section provides a comprehensive review of the existing literature on AI-based chatbots in language learning, serving as the foundational basis for this study. The review is structured into five key subtopics: the role of AI chatbots in language education, engagement strategies in AI-assisted learning, personalization and adaptability in chatbot-based learning, challenges in AI-driven language learning, and research gaps with future directions.

A. The Role of AI Chatbots in Language Education

Recent advancements in Artificial Intelligence (AI) have led to the widespread integration of chatbots into language learning. Cislowska and Pena-Acuna [17] argues that real-time feedback plays a crucial role in AI-driven language learning by allowing learners to correct mistakes instantly, improving their proficiency more efficiently. However, Petrović and Jovanović [18] caution that while AI-driven chatbots enhance autonomous learning, they may reduce students' reliance on human instructors, potentially limiting their exposure to natural conversational nuances essential for communicative competence. This debate suggests that while AI chatbots offer flexibility and independence, they may not fully replicate the depth and authenticity of human-led language instruction.

Research has further demonstrated that AI-driven chatbots significantly improve students' linguistic abilities through grammar corrections, interactive conversation practice, and real-time feedback [1]. Additionally, chatbots enhance accessibility, allowing learners to study at their own pace from any location and reducing dependence on traditional classroom instruction [3]. However, Kharis *et al.* [19] highlight that while AI chatbots provide adaptive learning experiences, their effectiveness in fully addressing individual learners' needs varies significantly based on the quality of AI algorithms and the specificity of their training datasets. This suggests that more empirical validation is required to determine how AI-driven personalization can cater to diverse learner profiles.

B. Engagement Strategies in AI-Assisted Learning

A significant challenge in AI-assisted education is maintaining learner engagement, as students may become disengaged due to a lack of human interaction, repetitive chatbot responses, or insufficient personalization of learning materials [20, 21]. Research indicates that gamification, real-world conversational simulations, and AI-driven personalization are among the most effective strategies for sustaining motivation and engagement [22, 23].

Yakubov *et al.* [24] found that gamification techniques, including reward-based learning, adaptive difficulty levels, and interactive challenges, significantly enhance short-term motivation. However, their study does not examine whether these effects persist over time. In contrast, Du and Daniel [25] discovered that real-world conversational simulations, rather than gamification, led to a 30% increase in long-term engagement, suggesting that interaction-based approaches may be more sustainable. These findings indicate that while gamification strategies offer immediate engagement, real-world conversational scenarios may be more effective for fostering sustained motivation. This gap in the literature necessitates further investigation into how different engagement strategies influence short-term and long-term learner retention.

Furthermore, gamified chatbot features, including rewards, challenges, and progress tracking, have increased student participation and knowledge retention [24, 26]. However, Zheng and Han [21] emphasize that adaptive feedback mechanisms tailored to individual learning patterns foster greater engagement and enhance long-term language retention. While these studies collectively highlight effective engagement strategies, further research is needed to determine whether gamification strategies can be optimized

to sustain motivation across different learner demographics and linguistic backgrounds.

C. Personalization and Adaptability in Chatbot-Based Learning

AI-driven chatbots enhance language learning by personalizing content according to students' proficiency levels. This is achieved through machine learning models that analyze user performance, track learning patterns, and predict areas requiring improvement. Moreover, chatbots leverage NLP to interpret user responses and dynamically adjust exercises in real-time, ensuring the learning experience remains relevant and appropriately challenging.

Studies have demonstrated that NLP-based personalization is highly effective for languages with abundant training data (e.g., English, Spanish) but significantly less effective for low-resource languages [27]. Song *et al.* [28] highlight that NLP-driven chatbots often struggle with languages that lack extensive digital corpora, raising concerns about whether AI-driven personalization can be universally applied across different linguistic contexts.

Additionally, while NLP allows chatbots to tailor learning materials dynamically, existing models still struggle to interpret nuanced linguistic expressions, dialects, and non-standard grammatical structures. Consequently, students learning minority or indigenous languages may receive less accurate and meaningful feedback, potentially limiting the effectiveness of AI chatbots for these groups. One possible solution is transfer learning, where models trained on high-resource languages can be fine-tuned to accommodate low-resource languages. However, empirical research evaluating the effectiveness of such an approach remains scarce, necessitating further exploration into scalable NLP adaptation methods for diverse linguistic settings.

D. Challenges in AI-Driven Language Learning

Despite AI chatbots' numerous advantages, several significant challenges persist across technical, pedagogical, and ethical domains. Addressing these challenges ensures that AI systems can effectively contribute to language learning without introducing unintended limitations.

Technically, AI chatbots often struggle to interpret complex linguistic nuances, such as idiomatic expressions, sarcasm, and cultural references. These challenges usually result in contextually inappropriate responses, which can impede the learning process and undermine the overall effectiveness of the AI system [29–31]. Additionally, the performance of chatbots tends to degrade when processing ambiguous phrases or regional dialect variations, limiting their ability to perform effectively in diverse linguistic and multilingual contexts [32]. Although significant progress has been made in enhancing NLP capabilities, existing models still face difficulties fully grasping the sociolinguistic subtleties necessary for effective communication. This limitation underscores the need to develop more sophisticated models incorporating a broader and more diverse array of linguistic data to improve accuracy and context comprehension.

From a pedagogical perspective, over-reliance on AI-generated feedback presents notable risks. Excessive reliance on automated corrections may impede the development of students' critical thinking and independent problem-solving abilities. Learners may passively accept AI-generated suggestions without fully engaging in the analysis of their mistakes, thereby reducing opportunities for deep cognitive processing and self-correction [33–35]. Furthermore, while AI-driven interactions can provide repeated exposure to language structures, they may inadvertently foster passive learning behaviors that diminish students' ability to engage in spontaneous, real-world conversations. This challenge is especially pertinent in vocational language education, where interactive, context-specific communication is crucial for students' career preparedness and professional language proficiency [36, 37].

Ethical concerns also arise when integrating AI into language learning systems. Data privacy is a significant concern, as AI chatbots often require access to user interactions and personal data to optimize learning algorithms and deliver personalized content [38, 39]. This raises critical questions regarding how AI systems store, process, and exploit student data. Furthermore, AI models are frequently trained on datasets that may inadvertently perpetuate algorithmic biases, reflecting dominant languages' linguistic structures and norms. This bias can limit the diversity of linguistic exposure for students, particularly those from marginalized language communities, thereby reinforcing inequalities in language education [40–42]. Moreover, as AI models become increasingly sophisticated, concerns about the potential displacement of human instructors are intensifying. While AI chatbots can serve as practical supplementary tools, their implementation must be carefully balanced with the recognition of the irreplaceable benefits of human-led instruction, such as emotional intelligence, adaptability, and the ability to respond to complex, real-time interpersonal dynamics [34, 43, 44].

Moreover, the growing reliance on AI feedback raises significant ethical concerns regarding its long-term cognitive impact. While AI-driven learning systems can enhance proficiency in certain language aspects, over-dependence on such technologies may impair students' ability to retain and apply language skills in authentic, unstructured environments. This could have profound implications for language acquisition and retention, particularly when learners rely on AI rather than engaging with real-world communicative situations. Therefore, future advancements in AI-assisted language learning must account for the need to foster immediate language competence and long-term retention.

E. Research Gaps and Future Directions

Although research on AI chatbots in education has significantly expanded in recent years, substantial gaps remain in understanding their long-term effectiveness. Studies by Gustafson *et al.* [20, 26] emphasize the necessity of conducting longitudinal research to assess whether AI chatbots can sustain learner engagement and improve learning outcomes over extended periods. Furthermore, Petrović and Jovanović [18] advocate for a deeper investigation into the role of AI-driven emotional intelligence in enhancing chatbot interactions and replicating human-like tutoring experiences.

Future research should adopt mixed-methods approaches integrating quantitative performance data with qualitative insights from learners to offer a more comprehensive

insights from learners to offer a more comprehensive understanding of AI chatbots' impact on language acquisition. Most existing studies concentrate on short-term gains in language proficiency, with limited exploration of sustained engagement and long-term retention [16]. Future studies should explore how AI chatbots can better incorporate emotional intelligence to simulate human interactions, offering more meaningful and engaging language learning experiences.

III. Methods

This study aimed to design, develop, and evaluate EduNetPro, a multilingual chatbot intended to improve student engagement and learning outcomes in French language education at the vocational high school level. A Design-Based Research (DBR) approach was employed, as this method allows for iterative improvements based on user feedback and real-world application [33, 34]. Unlike experimental and quasi-experimental designs, which typically require a control group and predefined treatment conditions, DBR focuses on continuous refinement and adaptation of educational tools within authentic classroom environments. This approach ensures that EduNetPro evolves dynamically based on real-time student interaction, making the findings more applicable to practical educational settings.

DBR was chosen over experimental methods for its flexibility in educational technology research, enabling continuous testing, evaluation, and refinement based on student engagement and performance data. While experimental designs establish causality through control-treatment comparisons, DBR ensures validity through multiple assessment methods, including pre-test and post-test evaluations, Likert-scale surveys, semi-structured interviews, and chatbot interaction logs. Using a mixed-methods approach, this study triangulates findings to ensure reliability and minimize bias. The absence of a control group is mitigated by comparing pre-test and post-test score improvements and analyzing engagement trends from survey responses and chatbot interaction data.

The study was conducted in vocational high schools in Medan, Indonesia, explicitly targeting Grade 11 students during the 2024/2025 academic year. Unlike general secondary education, vocational education emphasizes career-oriented and practical learning, which influences how students engage with foreign language acquisition. This distinction is essential, as vocational students require interactive, applied learning approaches, making AI-driven chatbot learning particularly relevant in this context.

Participants were selected through purposive sampling based on the following criteria:

1) Enrollment in vocational high schools, as the study targets explicitly language learning within vocational education settings.
2) Basic digital literacy skills ensured students could effectively engage with the chatbot.
3) Willingness to participate in the entire research process, including pre-test and post-test assessments and chatbot interaction.

A. Application Design Framework

The design of EduNetPro began with a thorough needs students in learning French. This process involved interviews with students and teachers to pinpoint key obstacles, such as limited access to personalized learning materials and the lack of immediate feedback. Based on these insights, core features such as an interactive chatbot, progress tracking, and multilingual support were designed to address these challenges and improve the learning experience.

Following the needs analysis, the User Interface (UI) and User Experience (UX) design were developed using Figma to ensure ease of use and accessibility. The primary goal was to create an intuitive and engaging interface that allows students to interact seamlessly with the chatbot. Special attention was given to accommodating students with varying proficiency levels, ensuring the platform was inclusive and adaptable.

The design process also incorporated iterative feedback loops, allowing for continuous refinement based on user input. Fig. 1 illustrates the design flowchart, from identifying user needs to prototype testing and final development.

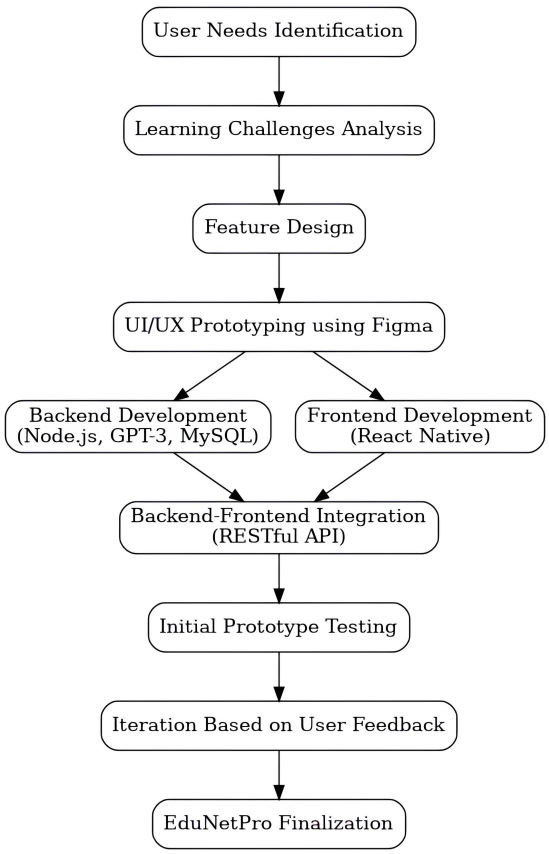

Fig. 1. EduNetPro application design process flowchart.

B. Application Development

The development of EduNetPro followed an iterative, user-centered approach to ensure the application effectively meets students' learning needs. The system architecture was designed using a modular structure, separating the backend and frontend for better scalability and maintainability.

The back-end was built using Node.js and NestJS, which were chosen for their high performance and scalability. The chatbot leverages OpenAI's GPT-3 for NLP, generating contextually accurate and interactive responses in French. Additionally, MySQL was used as the database to store user profiles, learning progress, and conversation logs, ensuring

data integrity and real-time adaptability.

On the frontend, React Native was implemented to ensure cross-platform compatibility across Android and iOS devices. The UI was designed to be responsive and user-friendly, allowing students to navigate the application effortlessly. RESTful Application Programming Interfaces (APIs) were integrated to facilitate real-time interactions, ensuring smooth communication between the back and frontend. Fig. 2 illustrates the system architecture, detailing how different components—NLP processing, databases, and UI—work together to deliver a seamless and dynamic learning experience.

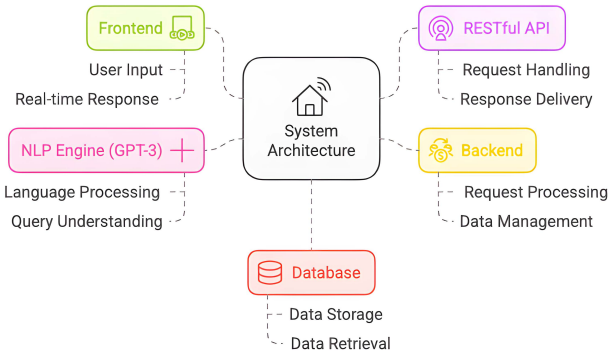

Fig. 2. System architecture diagram of EduNetPro.

C. User Testing

User testing was conducted to evaluate EduNetPro's effectiveness in providing an interactive and engaging learning experience. A total of 50 students from five different vocational high schools in Medan participated in the testing phase. Each school selected 10 students in Grade 11 during the 2024/2025 academic year. The participants were chosen through purposive sampling, ensuring they had basic digital literacy and a willingness to engage with the chatbot for French language learning.

As shown in Table 1, the participants were divided based on gender and school, each providing a balanced number of male and female students. The table below shows the gender distribution among the schools involved in the user testing.

Table 1. Distribution of user testing participants

School	Number of Students	Gender	
		Male	Female
Vocational High Schools A	10	6	4
Vocational High Schools B	10	5	5
Vocational High Schools C	10	7	3
Vocational High Schools D	10	4	6
Vocational High Schools E	10	5	5
Total	**50**	**27**	**23**

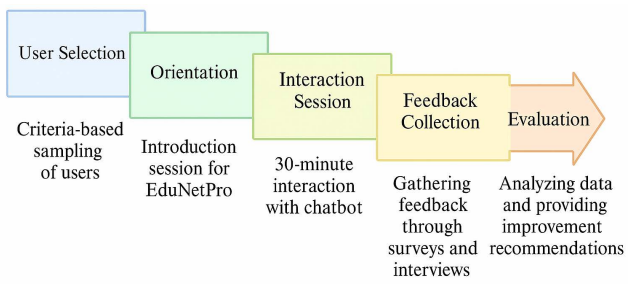

Fig. 3. EduNetPro user testing process.

Fig. 3 represents the crucial stages students underwent during the application's testing process, which aimed to enhance their engagement in learning French. The process begins with user selection, where students are chosen based on specific criteria, such as essential experience with digital devices, ensuring that they can use the application smoothly. Following this, orientation was conducted to guide the participants in using the application and familiarize them with its main features, such as vocabulary exercises, chatbot conversations, and progress tracking.

After the orientation, participants proceeded to the Interaction Session, where they practiced using the application to improve their language skills, for example, through conversation practice or vocabulary exercises. These Interactive sessions lasted approximately 30 minutes. During this time, student interactions with the application were recorded and analyzed to assess how effectively the application maintained their engagement.

After the interaction sessions, Feedback Collection took place, where feedback was gathered from participants through structured questionnaires and semi-structured interviews. The structured questionnaire was developed specifically for this study to assess students' satisfaction with key features of EduNetPro, including ease of navigation, progress tracking, real-time feedback, and chatbot accuracy. The instrument was constructed based on a review of existing literature on user satisfaction in educational technology and chatbot applications, as well as on the goals and features of EduNetPro. It included closed-ended questions using a Likert scale to quantify student perceptions. The questionnaire was designed to be simple, ensuring students could easily understand and respond to the questions.

The questionnaire underwent an expert review process to ensure its relevance and clarity. Educational technology experts and language educators reviewed the instrument to verify that the questions aligned with the study's objectives and the specific context of vocational education. Pre-testing was conducted with a small group of students to assess the reliability and clarity of the items, and adjustments were made based on their feedback. The final version of the questionnaire was validated to ensure reliability for measuring the constructs it intended to assess.

In addition to the questionnaire, semi-structured interviews were conducted with a subset of students to gather in-depth insights into their experiences using EduNetPro. These interviews explored students' perceptions of the chatbot's effectiveness, usability, and engagement level. Furthermore, interaction logs from EduNetPro were analyzed to assess the frequency and quality of student engagement with the platform, providing additional context to the quantitative results.

The process concluded with the Evaluation phase, where the testing results were collected and analyzed quantitatively through survey data and test results and qualitatively through interviews and interaction logs. The evaluation aimed to measure the application's success in increasing student engagement and learning outcomes and recommend further improvements.

D. Evaluation and Data Analysis

This study employed a mixed-methods approach to evaluate the effectiveness of EduNetPro in enhancing language proficiency and student engagement. The

evaluation methods included quantitative and qualitative data collection techniques, which were analyzed using various statistical tools to assess the intervention's impact. The following section outlines the evaluation methods and describes the data analysis techniques.

1) Evaluation methods overview

a) Quantitative data collection

Quantitative data were primarily collected through pre-test and post-test assessments, which measured students' language proficiency before and after using EduNetPro. The results were analyzed to determine if significant improvements in language skills occurred. Additionally, a questionnaire was administered to assess students' satisfaction with key features of the application, including ease of navigation, progress tracking, real-time feedback, and chatbot accuracy.

The Likert scale survey is widely used in social science research to measure attitudes, perceptions, or opinions on a particular subject. It typically presents respondents with a statement, and they are asked to indicate their level of agreement or disagreement on a scale ranging from 'strongly disagree' to 'strongly agree.' In this study, we utilized a 5-point Likert scale to assess students' satisfaction with key features of the EduNetPro application, such as ease of navigation, progress tracking, real-time feedback, and chatbot accuracy. The questionnaire consisted of closed-ended questions with a Likert scale to measure student satisfaction with the application's core features. This questionnaire was developed to collect quantitative data regarding user experience, which was then analyzed using descriptive statistics to summarize the results—the assessment aimed to gather a deeper understanding of students' perceptions of EduNetPro.

b) Qualitative data collection

Semi-structured interviews were conducted with some students to gather in-depth insights into their experiences using EduNetPro. These interviews explored students' perceptions of the chatbot's effectiveness, usability, and engagement level. Furthermore, interaction logs from EduNetPro were analyzed to assess the frequency and quality of student engagement with the platform, providing additional context to the quantitative results.

2) Data analysis techniques

The data analysis focused on interpreting the quantitative and qualitative data through various statistical methods, ensuring a comprehensive assessment of EduNetPro's impact. The specific techniques applied were:

a) Descriptive statistics

Descriptive statistics, such as mean, standard deviation, and percentage improvements, were used to summarize the pre-test and post-test scores. This provided an overview of the general trends in student performance and the effectiveness of EduNetPro in enhancing language proficiency. Similarly, descriptive statistics were used to summarize the survey results, providing insights into overall student satisfaction with the platform.

b) Paired t-test

To determine whether the improvement in student performance from the pre-test to the post-test was statistically significant, a paired t-test was conducted. This test compared the means of the two related groups (pre-test and post-test scores) to evaluate if the observed differences were more significant than would be expected by chance. A p-value of less than 0.05 indicated that the improvement was statistically significant, confirming that EduNetPro had a meaningful impact on language proficiency.

c) One-way ANOVA

A one-way Analysis of Variance (ANOVA) was conducted to compare post-test scores across different vocational schools. This helped assess whether there were significant differences in how students at various schools benefitted from the intervention. The ANOVA compared the means of post-test scores across groups (schools) and helped determine if the intervention had a uniform effect across schools.

d) Regression analysis

Linear regression was used to examine the relationship between pre-test and post-test scores. This analysis assessed whether initial proficiency levels (pre-test scores) could predict improvements in post-test scores. The R^2 value was used to measure how well the model explained the variance in post-test scores. A high R^2 value indicated that pre-test performance was a good predictor of post-test improvement.

e) Effect size (Cohen's d)

Cohen's d statistic was calculated to assess the magnitude of the improvement in student's language proficiency, providing an understanding of the practical significance of the intervention, regardless of sample size. Cohen's d is commonly used to measure effect size, which indicates how significant the observed effect is compared to the variability in the data. The values of Cohen's d are interpreted as follows: a small effect is represented by a value of 0.2, a medium effect by 0.5, and a significant effect by 0.8. These interpretations help gauge the real-world impact of the intervention beyond just statistical significance.

f) Thematic analysis of interview data

The qualitative data from the semi-structured interviews were analyzed using thematic analysis. This process identified key themes and patterns in students' experiences, including their perceptions of EduNetPro's usability, engagement, and effectiveness. The thematic analysis provided more profound insights into the factors influencing students' learning experiences and interaction with the chatbot.

g) Interaction log analysis

The interaction logs from EduNetPro were analyzed to assess student engagement frequency and patterns. By examining the number of interactions and the time spent on various tasks, this analysis provided insight into how actively students used the platform and how engaging the chatbot was in promoting language practice.

IV. Result

This section presents the study's key findings based on data collected from pre-test and post-test assessments, surveys, semi-structured interviews, and interaction logs. The results are organized into several key areas: application design, user testing, chatbot performance, student engagement, learning

outcomes, and student feedback.

A. Application Design Framework

The design of EduNetPro was crafted with a focus on usability and accessibility, ensuring that it would function effectively as a language learning tool for vocational high school students. The User Interface (UI) was developed using Figma, a design tool that enabled the creation of an intuitive and responsive layout compatible with both Android and iOS platforms. This design approach ensured that students could easily navigate the application regardless of their device. Given the specific needs of vocational students—who often require more interactive and adaptive learning tools—EduNetPro incorporated features such as real-time progress tracking and multilingual support. These features were specifically designed to provide a personalized learning experience for students.

The real-time progress tracking feature allowed students to monitor their learning journey, providing a sense of achievement as they saw improvements over time. This feature motivated students to continue engaging with the application, as they could visually see their advancement. Additionally, multilingual support was integrated into the platform to ensure that students from diverse linguistic backgrounds could fully engage with the content, further enhancing accessibility. These thoughtful design choices ensured that EduNetPro was effective and inclusive.

The UI design was intentionally kept straightforward and user-friendly to minimize navigation barriers. This allowed students to focus on the learning content rather than struggling with the technology. EduNetPro's design aimed to engage students at various proficiency levels by offering interactive content that was both effective and enjoyable. The platform was built to ensure that students, no matter their language background or proficiency level, could interact with the content meaningfully and enjoy their learning experience.

Fig. 4 illustrates the wireframe and mockups of the application, which showcase key features and their layout. The home menu (a) acts as the central hub, where students can access all the app's available features. The learning material section (b) is structured to ensure a clear presentation of lessons and exercises, making it easy for students to follow. The exercise section (c) offers various tasks and activities tailored to different proficiency levels, allowing students to progress at their own pace. Finally, the discussion of exercises (d) feature enables students to interact with the content, providing immediate feedback and suggestions for further improvement. This well-thought-out design not only improved the functionality of EduNetPro but also elevated the overall learning experience, making it more accessible and enjoyable for all students.

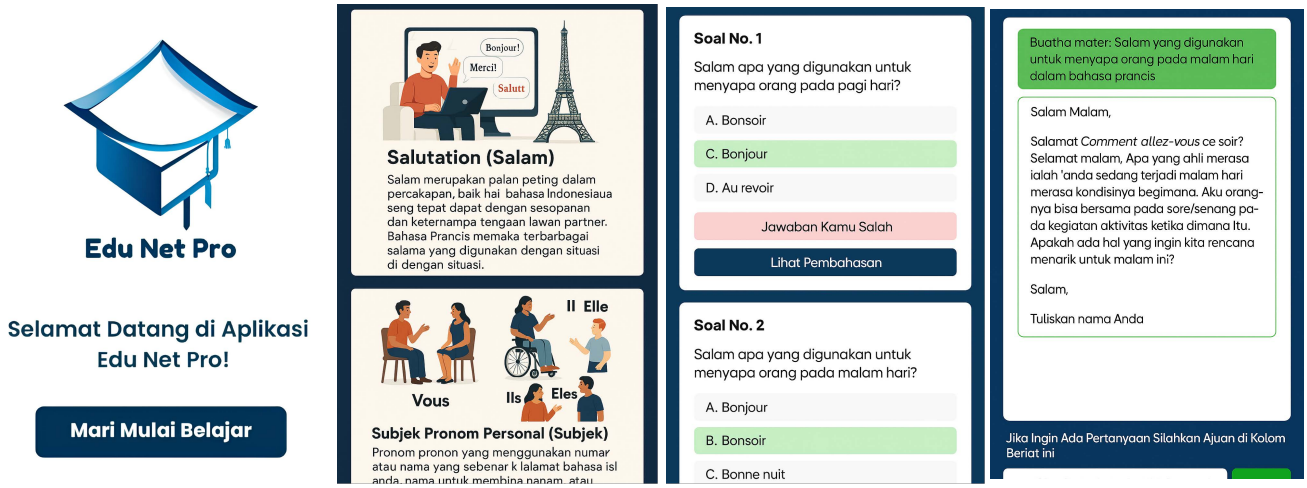

Fig. 4. EduNetPro application display wireframe. (a) home menu; (b) learning material; (c) exercise; (d) discussion of exercises.

B. User Testing Results

The user testing phase of EduNetPro involved collecting feedback through a Likert scale survey to evaluate students' satisfaction with key application features. The survey covered four primary aspects of the application: ease of navigation, progress tracking, real-time feedback, and chatbot accuracy. The results of this survey, presented in Table 2, reveal that most students expressed high levels of satisfaction with EduNetPro's core features.

Table 2. Satisfaction rates for key features (Likert scale survey results)

Feature	Average Score (1–5)
Ease of Navigation	4.6
Progress Tracking	4.5
Real-Time Feedback	4.8
Chatbot Accuracy	4.7

First, ease of navigation received an impressive average score of 4.6 on the 1–5 scale. This indicates that the students found the EduNetPro interface highly intuitive and user-friendly. The straightforward design of the application allowed students to engage with its features without encountering significant barriers, such as complicated menus or difficult-to-navigate sections. This positive feedback suggests that EduNetPro succeeded in providing a seamless user experience, enabling students to focus more on learning rather than struggling with the application itself.

Next, the progress tracking feature earned a solid average score of 4.5. This result highlights that students greatly appreciated the ability to track their learning progress throughout their application use. Seeing their improvement over time was a valuable motivator for many students, providing them with tangible evidence of their growth. The progress tracking feature helped create a sense of achievement, encouraging continued engagement with the

application and reinforcing their commitment to language learning.

The real-time feedback feature stood out with the highest satisfaction score of 4.8, reflecting its immense value to students. Real-time feedback is essential for effective language learning, enabling students to understand their mistakes and correct them on the spot immediately. The high score indicates that students found the instant feedback provided by the chatbot to be one of the most beneficial aspects of EduNetPro. This immediate response not only helped students identify errors but also contributed to enhancing their understanding of the material. The chatbot fostered a more interactive and productive learning environment by offering real-time corrections and guidance.

Finally, the chatbot accuracy feature received a strong average score of 4.7, demonstrating that students were generally satisfied with the chatbot's ability to provide accurate and contextually relevant responses. This feature was vital for ensuring students' conversations with the chatbot were meaningful and educational. The chatbot's accuracy in understanding and responding to student inputs helped maintain the learning process flow, providing appropriate answers to students' queries and assisting them in refining their language skills.

In summary, the results from the Likert scale survey indicate that EduNetPro was well-received by students. Each core feature—ease of navigation, progress tracking, real-time feedback, and chatbot accuracy—received high satisfaction scores, confirming that the application effectively met students' needs. The user-friendly navigation, progress-tracking capabilities, and immediate, personalized feedback created an engaging and practical learning experience. These findings suggest that EduNetPro enhanced students' language learning journey, making it a valuable tool for improving their proficiency and engagement.

C. Chatbot Performance

The performance of the EduNetPro chatbot was evaluated across three distinct conversational categories: vocabulary exercises, basic conversations, and complex conversations. This evaluation aimed to assess the chatbot's accuracy and overall effectiveness in supporting language learning through its performance at various levels of conversational complexity.

In the vocabulary exercises category, the chatbot demonstrated exceptional performance, achieving an accuracy rate of 95%. This result indicates that EduNetPro is highly effective in facilitating students' acquisition and practice of French vocabulary. The chatbot's ability to accurately identify and define vocabulary is essential for building a strong linguistic foundation, especially at the beginner level. Since vocabulary acquisition is a core aspect of language learning, these findings suggest that EduNetPro provides a reliable and robust platform for students to reinforce their understanding of key language terms.

The chatbot's performance in basic conversations was similarly strong, with an accuracy rate of 90%. This reflects the chatbot's effectiveness in managing structured dialogues, such as greetings, introductions, and simple exchanges, which are fundamental for students to build confidence in their spoken language skills. The high accuracy in basic conversational tasks demonstrates the potential of EduNetPro to support students in developing their communication abilities within controlled contexts. However, while the accuracy in this category is high, the performance may be affected by the limitations inherent in handling dynamic, unscripted conversations, indicating the need for further enhancement in conversational adaptability.

The chatbot's performance experienced a slight decline in complex conversations, with an accuracy rate of 85%. This drop is consistent with NLP models' challenges when dealing with more nuanced dialogues, including idiomatic expressions, colloquialisms, and context-dependent language. Complex conversations often require understanding subtleties in language use, such as tone, cultural references, and multiple meanings of words. As NLP models typically struggle with these intricacies, the decrease in accuracy in this category underscores the need for ongoing improvements in the chatbot's ability to interpret and generate contextually appropriate responses in advanced conversations.

EduNetPro can support essential language learning, particularly vocabulary acquisition and simple conversational exchanges. However, the decline in performance for complex conversations highlights the current limitations of NLP models, particularly in handling advanced language constructs and context-sensitive communication. These results suggest that while EduNetPro is an effective tool for foundational language learning, there is a clear need for continued refinement to enhance its capabilities in more complex linguistic scenarios.

Table 3 summarizes the chatbot's performance across these three categories: 95% accuracy in vocabulary exercises, 90% in basic conversations, and 85% in complex discussions.

Table 3. Chatbot accuracy metrics

Feature	Satisfaction (%)
Vocabulary Exercises	95
Basic Conversations	90
Complex Conversations	85

These findings confirm that EduNetPro supports students' foundational language skills, particularly vocabulary acquisition and essential conversational practice. Nevertheless, for the chatbot to serve as a comprehensive language learning tool, future development should prioritize improving its performance in more complex dialogues. Advancements in NLP and machine learning algorithms will enhance EduNetPro's capacity to handle advanced conversational contexts and provide a more robust learning experience for all proficiency levels.

D. Student Engagement

Student engagement was evaluated by analyzing the interaction logs during the user testing phase. The Student Engagement Graph in Fig. 5 illustrates each student's interactions during a 30-minute session. The graph shows a range of engagement levels, with some students making as many as 62 interactions and others making around 45.

The variation in engagement levels provides valuable insights into the effectiveness of EduNetPro in motivating students to participate in the learning process. Although the chatbot succeeded in engaging a significant portion of students, further refinement of the application could improve engagement for students who interacted less frequently.

Future developments should focus on tailoring content to individual learning styles and increasing interactivity to enhance engagement.

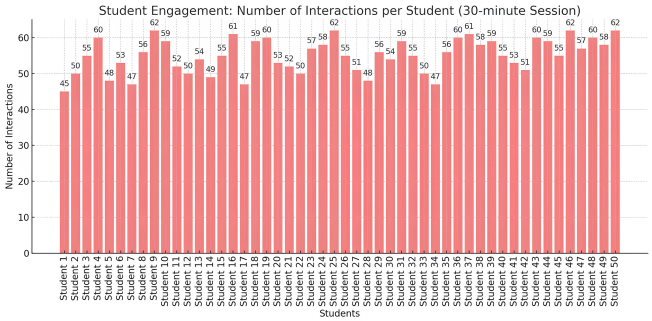

Fig. 5. Student engagement: number of interactions per student (30-minute session).

E. Learning Outcomes

The impact of EduNetPro on students' language proficiency was evaluated through pre-test and post-test assessments. The results showed a significant increase in the average score of students, with a 24% improvement from the pre-test to the post-test. This indicates a notable enhancement in language skills after using EduNetPro.

Table 4. Pre-test and post-test results

School	Pre-Test Average (%)	Post-Test Average (%)	Improvement (%)
Vocational High Schools A	62	86	24
Vocational High Schools B	58	83	25
Vocational High Schools C	60	84	24
Vocational High Schools D	61	85	24
Vocational High Schools E	59	82	23
Average	**60**	**84**	**24**

Table 4 presents the pre-test and post-test results for students across five schools involved in the study. The average pre-test score was 60%, which increased to 84% on the post-test, showing an average improvement of 24%.

A paired t-test was conducted to confirm that this improvement was statistically significant. The t-test results showed a t-value of −75.89 and a very small p-value of 1.81×10^{-7}, indicating that the difference between pre-test and post-test scores is statistically significant ($p < 0.05$). This confirms that using EduNetPro contributed to a substantial improvement in students' language proficiency. The detailed results of the paired t-test are provided in Table 5 Paired T-Test.

Table 5. Paired t-test statistical results

Statistic	Result
T-Value	−75.89
p-Value	1.81×10^{-7}
Mean Improvement (%)	24%
Standard Deviation of Difference	0.63

Additionally, Fig. 6 visually illustrates the comparison between pre-test and post-test scores. This figure shows consistent improvement across all five schools, highlighting the positive impact of EduNetPro on students' language proficiency. The average improvement of 24%, with a standard deviation of 0.63, demonstrates that the improvement was consistent among the students, further supporting the effectiveness of EduNetPro in enhancing language skills.

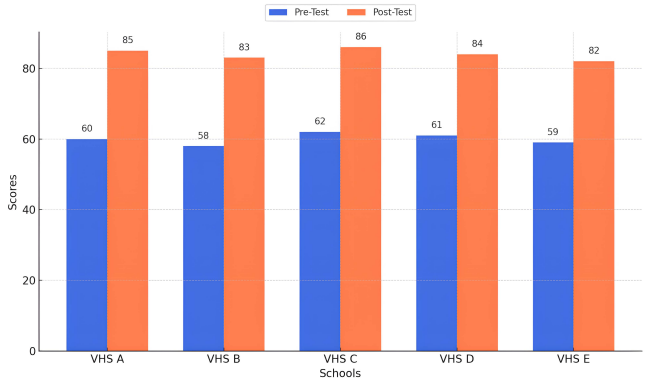

Fig. 6. Pre-test and post-test scores.

F. Student Feedback

Qualitative feedback from semi-structured interviews provided valuable insights into the students' experiences with EduNetPro. According to Table 6, 80% of students reported feeling more engaged in their learning after using EduNetPro. The interactive exercises and chatbot-based conversations contributed to a more enjoyable learning experience, motivating students to practice more frequently. Moreover, 90% of students appreciated the chatbot's ability to provide instant feedback, allowing them to correct mistakes immediately and enhance their understanding of the material.

Table 6. Student feedback on EduNetPro

Aspect	Positive (%)	Negative (%)	Qualitative Comments
Ease of Use	85	15	"The application is very easy to use; I had no trouble navigating it."
Engagement	80	20	"I feel more engaged in learning, especially with the interactive exercises."
Instant Feedback	90	10	"The quick feedback helps me understand my mistakes immediately."
Content Quality	75	25	"The content is very good, but I would like more variety in the exercises."
Customization	60	40	"I wish I could customize my learning goals more."

However, some students expressed a desire for more varied content, with 25% suggesting that the exercises should cover more complex conversation scenarios to better align with their developing language skills. Additionally, 40% of students requested more personalized features, such as the ability to set learning goals or customize the chatbot's interaction style to suit their preferences better. These insights suggest that future iterations of EduNetPro should focus on expanding the range of conversation scenarios and incorporating more personalized learning features, enhancing the application's overall effectiveness and better meeting the needs of diverse learners.

G. Statistical Analysis

1) ANOVA analysis

A one-way ANOVA test was conducted to determine whether there were significant differences in the post-test scores of students from different schools after using the EduNetPro application. The results of the analysis, presented in Table 7, show that the Sum of Squares between groups was 10.0, with a Mean Square of 2.5. The calculated F-value was 0.0, and the p-value was NaN (Not a Number), indicating no statistically significant differences between the post-test scores of students from the various schools.

These results suggest that despite some variations in the scores across the schools, the differences were not substantial enough to be considered significant. The F-value of 0.0 and the *p*-value of NaN indicate that the variations in post-test scores were likely due to random chance rather than any systematic effect of the EduNetPro intervention. One possible Explanation for this lack of significance is the relatively small sample size used in the study, which consisted of only five schools and 50 students. This small sample size may have limited the test's statistical power, making it difficult to detect significant differences if they existed.

Table 7. One-way ANOVA results for Post-Test scores across schools

Source	Sum of Squares	df	Mean Square	F	*p*-value
Between Groups	10.0	4	2.5	0.0	NaN
Within Groups	NaN	0	NaN	NaN	NaN

df = degrees of freedom

In conclusion, the one-way ANOVA test, as summarized in Table 7, revealed no significant differences in the post-test scores among the schools, suggesting that the EduNetPro intervention did not produce varying results based on the participating schools. This outcome highlights the need for further research with larger sample sizes to explore potential effects comprehensively.

2) Regression analysis

A linear regression analysis investigated the relationship between pre-test and post-test scores. The aim was to determine whether students' initial proficiency levels, as indicated by their pre-test scores, could predict their improvements in post-test scores after using the EduNetPro application. The regression model revealed a significant positive relationship between pre-test and post-test scores, with a regression coefficient of 0.9 for the pre-test score. This means that for every one-point increase in the pre-test score, there was a corresponding increase of 0.9 points in the post-test score.

The R^2 value for the model was 0.81, indicating that the pre-test scores can explain 81% of the variance in post-test scores. This strong correlation suggests that students' initial proficiency levels are a key determinant of their subsequent performance after the intervention. Additionally, the F-statistic was 12.79, with a *p*-value of 0.037, which is statistically significant ($p < 0.05$). This confirms that the relationship between pre-test and post-test scores is not due to random chance but reflects a meaningful and predictable pattern.

As presented in Fig. 7, the regression analysis highlights that students with higher initial proficiency levels, as measured by their pre-test scores, demonstrated more significant improvements in their post-test scores. Fig. 7 illustrates the linear relationship between the pre-test and post-test scores, showing how the improvement in post-test scores correlates with initial proficiency levels. This finding suggests that while the EduNetPro intervention positively affected all students, its impact was more pronounced among those with higher pre-test scores.

In conclusion, the regression analysis provides robust evidence that pre-test scores significantly predict post-test improvements. The findings, summarized in Table 8, emphasize that initial language proficiency plays a critical role in determining the success of the EduNetPro intervention in enhancing students' language skills.

Table 8. Regression analysis results

Variable	Coefficient	Std. Error	t-value	*p*-value	95% CI lower	95% CI upper	F-statistic	R^2
Intercept	30.0	15.14	1.986	0.141	−18.067	78.067		
Pre-Test Score	0.9	0.252	3.576	0.037	0.099	1.701	12.79	0.81

Std. Error = Standard Error; R^2 = coefficient of determination

Fig. 7. Regression analysis: Pre-test vs. Post-test scores.

3) Effect size (Cohen's d)

Cohen's d statistic was calculated to assess the magnitude of the improvement in students' language proficiency following using EduNetPro. Cohen's d is a measure of effect size that quantifies the difference between two means relative to the variability in the data. This study used Cohen's d to determine the practical significance of the difference between pre-test and post-test scores, providing insight into how meaningful the observed changes were regarding language proficiency.

The mean improvement in post-test scores was 24 percentage points, with a standard deviation of 0.707. The calculated Cohen's d value was 33.94, which is considered a considerable effect size, far exceeding conventional benchmarks (small = 0.2, medium = 0.5, and large = 0.8). This significant effect size suggests that the EduNetPro intervention significantly impacted students' language proficiency, highlighting the statistical significance of the improvement and its practical importance in enhancing

language skills.

Table 9. Effect size analysis results

Metric	Value
Mean Improvement	24.000
Standard Deviation	0.707
Cohen's d	33.941

The Cohen's d calculation results are presented in Table 9, demonstrating substantial improvements in students' language proficiency. With a Cohen's d value of 33.941, the effect size is considerable, confirming that EduNetPro had a strong and meaningful impact on language learning outcomes. These findings underline the effectiveness of the EduNetPro application as a tool for enhancing language skills in an educational context.

V. Discussion

A. Interpretation of Findings

The findings of this study highlight the significant impact of EduNetPro, an AI-powered chatbot, on student engagement and language proficiency in vocational high schools. The 24% average increase in post-test scores, with the highest improvement reaching 25%, underscores the effectiveness of AI-driven learning tools in enhancing students' French language skills. This improvement is an academic achievement and reflects practical language proficiency gains. A 24% improvement in language proficiency suggests that students will likely feel more confident and competent in real-world communication, such as workplace interactions, professional conversations, and job-related discussions.

These results align with previous studies that indicate AI chatbots can facilitate interactive, self-directed learning experiences, contributing to measurable improvements in language proficiency [1, 3, 31]. In line with these findings, previous research on other AI-driven language learning platforms, such as Babbel, also reports significant performance improvements. A study by Loewen *et al.* [45] on Babbel demonstrated a 25% increase in proficiency among learners after six months of consistent use, highlighting the potential for AI tools like EduNetPro to achieve similar outcomes. Furthermore, a meta-analysis by Lee and Lee [46] found that AI-based tools such as Babbel contributed to measurable improvements in both language retention and proficiency, further supporting the effectiveness of such tools in language education. Similarly, platforms like Duolingo have shown impressive results in language acquisition, with Vesselinov & Grego [47] reporting a 30% improvement in vocabulary proficiency after eight weeks of use. Collectively, these studies reinforce the findings of this research, positioning EduNetPro as part of a growing trend of AI-driven educational tools that are transforming language learning through personalized, adaptive, and engaging interactions.

Beyond the measurable improvement in test scores, EduNetPro also positively influenced student engagement and motivation. Survey results reveal that 80% of students felt more engaged in their learning process, while 90% found real-time feedback helpful in refining their language skills. This supports previous research by Tan and Cheah [20], emphasizing that instant feedback fosters active learning by enabling students to recognize and correct their errors immediately. However, while the chatbot demonstrated high accuracy in vocabulary exercises (95%) and basic conversations (90%), its performance declined in complex dialogues (85%), indicating that current NLP models still face challenges in grasping contextual nuances and idiomatic expressions [32, 33].

B. Comparison with Previous Studies

The findings of this study reinforce the growing body of research on AI-driven language learning, particularly in how chatbots enhance accessibility, engagement, and personalized learning experiences. Prior studies have consistently shown that chatbot-based learning facilitates greater autonomy and interaction, reducing dependence on traditional classroom settings [8, 9, 34]. This study empirically supports those claims by demonstrating how EduNetPro successfully bridges the gap between structured classroom instruction and self-directed language learning.

Furthermore, this study confirms the effectiveness of gamification and adaptive learning pathways in maintaining student motivation. Research by Du and Daniel [25] has shown that gamification elements—such as rewards, challenges, and progress tracking—can improve student retention and learning outcomes by up to 30%. EduNetPro enhances this approach by incorporating context-specific rewards and challenges tailored to the vocational learning environment. Unlike platforms such as Duolingo or Babbel, which focus on general language tasks like basic conversations or vocabulary exercises, EduNetPro introduces real-world professional scenarios that allow students to earn rewards for completing tasks like simulated workplace conversations or job-related dialogues. This contextual gamification aligns with the needs of vocational students, providing more meaningful and career-relevant language practice.

Given that vocational students often exhibit lower intrinsic motivation for language learning than students in academic tracks [11, 35], these findings underscore the importance of incorporating interactive, reward-based elements in AI-powered learning tools. EduNetPro's gamification, which targets vocational communication scenarios, helps students stay engaged by offering language practice that prepares them for future careers.

Despite these advantages, one potential drawback of AI-driven learning tools is the risk of student over-reliance on automated feedback. Studies by Wu and Yu [30] suggest that while AI chatbots improve accuracy and engagement, they may inadvertently limit students' ability to develop independent problem-solving skills and critical thinking in language learning. This study acknowledges this concern and suggests that future chatbot development should integrate mechanisms encouraging students to analyze their mistakes more deeply rather than passively relying on AI-generated corrections.

C. Implications of the Study

The results of this study have essential pedagogical and technological implications for AI-assisted language learning, particularly in vocational education settings.

First, the chatbot's ability to provide instant, adaptive

feedback fosters a more interactive and engaging learning experience, which is crucial for maintaining student motivation. This suggests that educational institutions, especially vocational schools, should consider integrating AI-driven chatbots into their language curricula as a supplementary tool to enhance classroom learning.

Second, the findings highlight the importance of personalization in AI-assisted education. EduNetPro demonstrated strong adaptability to individual learning needs, supporting research by Zheng and Han [21], which suggests that AI-driven adaptive learning environments improve student performance by tailoring content based on individual progress and proficiency levels. To optimize learning outcomes, future implementations should enhance chatbot personalization features, such as customized learning goals and individualized learning paths.

Furthermore, while EduNetPro has proven effective in enhancing student engagement and language proficiency, it is essential to emphasize the need for a hybrid model that combines the strengths of both AI technology and human instruction. This model enables a more balanced approach, where AI-driven chatbots can handle more structured, data-driven tasks while human instructors provide emotional support, contextual explanations, and deeper social interactions. This will improve the effectiveness of language learning, providing students the opportunity to learn independently through AI while also receiving guidance from teachers for more complex challenges. This hybrid model creates a more holistic learning experience, especially in vocational education settings where students often require additional support beyond technology-based instruction.

Additionally, integrating Emotional Intelligence (EI) into EduNetPro will provide an additional dimension to enhance the learning experience. EI refers to recognizing and responding to students' emotions, which is critical in language learning, as students often experience anxiety and frustration, particularly in conversation-based activities. For instance, if the chatbot detects that a student is feeling anxious or struggling to answer a question, it can offer positive reinforcement or adjust the task difficulty to align with the student's comfort level. This approach can help students feel more valued and supported emotionally, improving their emotional engagement in learning and reducing psychological barriers that may arise while learning a language. Thus, incorporating emotional intelligence in EduNetPro would foster a more empathetic and emotionally connected learning experience for students.

Finally, this study reinforces the need for a balanced integration of AI and human instruction. While EduNetPro has proven effective in enhancing engagement and proficiency, AI chatbots cannot entirely replace human instructors. Instead, an optimal approach would be a hybrid model, where chatbots facilitate practice and reinforcement while teachers provide contextual explanations, emotional support, and deeper discussions of linguistic nuances.

VI. Conclusion

This study demonstrates the significant potential of AI-driven chatbots like EduNetPro to enhance student engagement and language proficiency in vocational high schools. Implementation resulted in a 24% average improvement in students' proficiency, with high levels of engagement reported. The findings underscore the value of integrating adaptive and interactive AI technologies into language education to meet vocational students' specific learning needs. Technological advancement and complementary human instruction remain essential to optimize language learning outcomes.

The findings highlight the potential benefits of integrating AI-based adaptive technologies into vocational language education. While promising, continued advancements in chatbot technology, complemented by human instructional methods, remain critical to optimizing language learning outcomes. This study contributes to a growing understanding of how AI tools can practically support language proficiency and learner engagement in specialized educational environments.

Despite these positive findings, this study has several limitations. The absence of baseline data limits the ability to attribute improvements solely to EduNetPro, as external factors may have influenced outcomes. Additionally, the relatively small sample size and limited geographical scope constrain the generalizability of the results. Another challenge is the chatbot's reduced accuracy in handling complex conversations, indicating the need for further refinement of natural language processing models. Moreover, the short duration of the study prevents conclusions about long-term language retention.

To address these limitations, future research should consider expanding the sample size and diversity, implementing longer study durations, and employing more controlled experimental designs. Future work may also explore the integration of more advanced AI capabilities to improve contextual understanding, emotional responsiveness, and adaptability. Comparative studies between AI-based tools and conventional instruction methods would provide valuable insights into optimal hybrid models. Finally, longitudinal studies are needed to assess the sustainability of learning gains and the impact of AI chatbots on long-term language acquisition.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

H. F. led the literature review and contributed to the design of the EduNetPro learning framework; B. D. W. conceptualized the study, supervised the application development, and led the manuscript writing; T. T. A. P. was responsible for the system architecture design and implementation of the chatbot using GPT-based NLP; T. R. S. conducted the user testing, collected and analyzed qualitative data, and contributed to the interpretation of results; N. H. handled the quantitative data analysis, including pre-test/post-test assessments and statistical evaluations. All authors reviewed and approved the final version of the manuscript.

Funding

This research was funded by the General Service Agency Fund (BLU) of Universitas Negeri Medan by the Decree of

the Head of the Institute for Research and Community Service Number: 108/UN.33/KEP/PPKM/PTI/2022.

ACKNOWLEDGMENT

The authors wish to express their deepest gratitude to the Rector of Universitas Negeri Medan and the Chair of the Academic Senate of Universitas Negeri Medan for their unwavering support and encouragement throughout the research and development of the EduNetPro application. Their commitment to advancing innovative language education in vocational settings has been instrumental in the success of this study.

REFERENCES

[1] L. Labadze, M. Grigolia, and L. Machaidze, "Role of AI chatbots in education: Systematic literature review," *International Journal of Educational Technology in Higher Education*, vol. 20, no. 1, 56, Oct. 2023.

[2] R. Sajja *et al.*, "Artificial intelligence-enabled intelligent assistant for personalized and adaptive learning in higher education," *Information*, vol. 15, no. 10, 596, Sep. 2024.

[3] Y. Wang and L. Xue, "Using AI-driven chatbots to foster Chinese EFL students' academic engagement: An intervention study," *Comput. Human Behav.*, vol. 159, 108353, Oct. 2024.

[4] H. Jiang *et al.*, "AI-powered chatbot communication with customers: Dialogic interactions, satisfaction, engagement, and customer behavior," *Comput. Human Behav.*, vol. 134, 107329, Sep. 2022.

[5] O. A. Al-Smadi *et al.*, "Artificial intelligence for English language learning and teaching: Advancing sustainable development goals," *Journal of Language Teaching and Research*, vol. 15, no. 6, pp. 1835–1844, Nov. 2024.

[6] H. Tiwari *et al.*, "AI-driven English language learning: Leveraging applications/APIs for dynamic content and feedback," *World Journal of Advanced Research and Reviews*, vol. 22, no. 3, pp. 1611–1616, June 2024.

[7] R. Abobaker and S. Moleta, "ESL 4.0: A practical guide to benefits, challenges, and best practices for AI-enhanced learning," *AI Applications and Strategies in Teacher Education*, Hershey: IGI Global Scientific Publishing, 2024, pp. 71–134.

[8] L. Chen, P. Chen, and Z. Lin, "Artificial intelligence in education: A review," *IEEE Access*, vol. 8, pp. 75264–75278, 2020.

[9] Z. Liu, W. Zhang, and P. Yang, "Can AI chatbots effectively improve EFL learners' learning effects?—A meta-analysis of empirical research from 2022–2024," *Comput. Assist. Lang. Learn.*, pp. 1–27, February 2025.

[10] N. Haristiani, "Artificial Intelligence (AI) chatbot as language learning medium: An inquiry," in *Proc. International Conf. on Education, Science and Technology 2019*, 2019, 012020.

[11] D. F. A. Husaeni *et al.*, "Chatbot artificial intelligence as educational tools in science and engineering education: A literature review and bibliometric mapping analysis with its advantages and disadvantages," *ASEAN Journal of Science and Engineering*, vol. 4, no. 1, pp. 93–118, Feb. 2024.

[12] B. M. Al-Muhaissen *et al.*, "The Pragmatic Function of Press Discourse Markers in French Language," *Business Analytical Capabilities and Artificial Intelligence-Enabled Analytics: Applications and Challenges in the Digital Era*, Cham: Springer Nature Switzerland, 2024, pp. 155–165.

[13] C. Joyez and C. Laffineur, "The occupation space: Network structure, centrality and the potential of labor mobility in the French labor market," *Appl. Netw. Sci.*, vol. 7, no. 1, 16, Mar. 2022.

[14] M. Ivanova, G. Grosseck, and C. Holotescu, "Unveiling insights: A bibliometric analysis of artificial intelligence in teaching," *Informatics*, vol. 11, no. 1, 10, Feb. 2024.

[15] C. Kooli, "Chatbots in education and research: A critical examination of ethical implications and solutions," *Sustainability*, vol. 15, no. 7, 5614, Mar. 2023.

[16] J. Lingaiah, S. N. Ishak, and P. K. Mishra, "AI-driven chatbots as language tutors: Enhancing written proficiency in ESL," *International Journal of Humanity and Social Sciences*, vol. 3, no. 5, pp. 78–95, Dec. 2024.

[17] A. I. Cislowska and B. Pena-Acuna, "Integration of chatbots in additional language education: A systematic review," *European Journal of Educational Research*, vol. 13, no. 4, pp. 1607–1625, Oct. 2024.

[18] J. Petrović and M. Jovanović, "The role of chatbots in foreign language learning: The present situation and the future outlook," *Artificial Intelligence: Theory and Applications*, Cham: Springer International Publishing, 2021, pp. 313–330.

[19] M. Kharis *et al.*, "Development of a chatbot app for interactive German grammar learning," *Int. J. of Emerg. Technol. in Learn. (iJET)*, vol. 17, pp. 52–63, July 2022.

[20] D. Y. Tan and C. W. Cheah, "Developing a gamified AI-enabled online learning application to improve students' perception of university physics," *Computers and Education: Artificial Intelligence*, vol. 2, 100032, 2021

[21] S. Zheng and M. Han, "The impact of AI enablement on students' personalized learning and countermeasures—A dialectical approach to thinking," *Journal of Infrastructure, Policy and Development*, vol. 8, no. 14, 10274, 2024.

[22] T. Ait Baha *et al.*, "The impact of educational chatbot on student learning experience," *Educ. Inf. Technol. (Dordr)*, vol. 29, no. 8, pp. 10153–10176, Sep. 2023.

[23] B. G. Banik and A. Gullapelly, "AI-powered gamification and interactive learning tools for enhancing student engagement," *Driving Quality Education Through AI and Data Science*, Hershey: IGI Global, 2025, pp. 283–310.

[24] A. Yakubov, Y. Nazarov, and A. A. Rodionov, "Advancing e-learning and m-learning environments incorporating AI and gamification to boost learner motivation," in *Proc. 2024 4th International Conf.on Technology Enhanced Learning in Higher Education (TELE)*, 2024, pp. 29–31.

[25] J. Du and B. K. Daniel, "Transforming language education: A systematic review of AI-powered chatbots for English as a foreign language speaking practice," *Computers and Education: Artificial Intelligence*, vol. 6, 100230, Jun. 2024.

[26] J. R. D. Gustafson *et al.*, "Enhancing project-based learning with a GenAI tool based on retrieval: Augmented generation and knowledge graphs," *AI Applications and Strategies in Teacher Education*, Hershey: IGI Global, 2025, pp. 161–194.

[27] R. Ramakrishnan *et al.*, "Revolutionizing campus communication: NLP-powered university chatbots," *International Journal of Advanced Computer Science and Applications*, vol. 15, no. 6, 2024.

[28] C. Song, S. Y. Shin, and K. S. Shin, "Implementing the dynamic feedback-driven learning optimization framework: A machine learning approach to personalize educational pathways," *Applied Sciences*, vol. 14, no. 2, 916, Jan. 2024.

[29] O. Ali *et al.*, "The effects of artificial intelligence applications in educational settings: Challenges and strategies," *Technol. Forecast. Soc. Change*, vol. 199, 123076, Feb. 2024.

[30] R. Wu and Z. Yu, "Do AI chatbots improve students learning outcomes? Evidence from a meta-analysis," *British Journal of Educational Technology*, vol. 55, no. 1, pp. 10–33, May 2023.

[31] M. A. Kuhail *et al.*, "Interacting with educational chatbots: A systematic review," *Educ. Inf. Technol.*, vol. 28, no. 1, pp. 973–1018, July 2022.

[32] T. Held and M. Mejeh, "Students' motivational trajectories in vocational education: Effects of a self-regulated learning environment," *Heliyon*, vol. 10, no. 8, e29526, Apr. 2024.

[33] Z. Zhang, "Advancements and challenges in AI-driven language technologies: From natural language processing to language acquisition," *Applied and Computational Engineering*, vol. 57, pp. 146–152, Apr. 2024.

[34] C. Zhai, S. Wibowo, and L. D. Li, "The effects of over-reliance on AI dialogue systems on students' cognitive abilities: A systematic review," *Smart Learning Environments*, vol. 11, no. 1, 28, June 2024.

[35] J. Yin *et al.*, "Using educational chatbots with metacognitive feedback to improve science learning," *Applied Sciences*, vol. 14, no. 20, 9345, Oct. 2024.

[36] P. Naveen and P. Trojovský, "Overview and challenges of machine translation for contextually appropriate translations," *iScience*, vol. 27, no. 10, 110878, Oct. 2024.

[37] K. Pahi *et al.*, "Enhancing active learning through collaboration between human teachers and generative AI," *Computers and Education Open*, vol. 6, 100183, June 2024.

[38] J. Yin, T. T. Goh, and Y. Hu, "Interactions with educational chatbots: The impact of induced emotions and students' learning motivation," *International Journal of Educational Technology in Higher Education*, vol. 21, no. 1, 47, Aug. 2024.

[39] C. C. Cain, C. D. Buskey, and G. J. Washington, "Artificial intelligence and conversational agent evolution—A cautionary tale of the benefits and pitfalls of advanced technology in education, academic research, and practice," *Journal of Information, Communication and Ethics in Society*, vol. 21, no. 4, pp. 394–405, Sep. 2023.

[40] L. H. Satiti, E. Fauziati, and E. Seytaningsih, "AI chatbot as an effective english teaching partner for university students," *International Journal of Educational Research & Social Sciences*, vol. 5, no. 3, pp. 463–469, June 2024.

[41] Y. K. Dwivedi *et al.*, "Opinion paper: 'So what if ChatGPT wrote it?' Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy," *Int. J. Inf. Manage.*, vol. 71, 102642, Aug. 2023.

[42] S. R. Viruel, E. S. Rivas, and J. R. Palmero, "The role of artificial intelligence in project-based learning: Teacher perceptions and pedagogical implications," *Educ. Sci.*, vol. 15, no. 2, 150, Jan. 2025.

[43] M. Yang. (March 2025). Artificial intelligence versus human teacher assistants and language learners' progress in learning and retention of complex sentences. *Current Psychology*. [Online]. Available: https://link.springer.com/article/10.1007/s12144-025-07488-6

[44] A. Mohebbi, "Enabling learner independence and self-regulation in language education using AI tools: A systematic review," *Cogent Education*, vol. 12, no. 1, 2433814, Dec. 2024.

[45] S. Loewen, D. R. Isbell, and Z. Sporn, "The effectiveness of app-based language instruction for developing receptive linguistic knowledge and oral communicative ability," *Foreign Lang. Ann.*, vol. 53, no. 2, pp. 209–233, June 2020.

[46] H. Lee and J. H. Lee, "The effects of AI-guided individualized language learning: A meta-analysis," *Language Learning & Technology*, vol. 28, no. 2, pp. 134–162, June 2024.

[47] R. Vesselinov and J. Grego. (December 2012). Duolingo effectiveness study. [Online]. Available: https://www.languagezen.com /pt/about/english/Duolingo_Efficacy_Study.pdf

Copyright © 2025 by the authors. This is an open access article distributed under the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited (CC BY 4.0).