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(REVIEW ARTICLE)

Development of EduChat: An Artificial Intelligence (A.I.) powered application as teachers co-pilot

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Abstract

This study addresses gaps in educational interactivity and teacher-student engagement by leveraging AI to develop a teacher co-pilot. Using platforms like Voiceflow and ChatDash, alongside agile development methodologies, EduChat enables teachers to upload instructional materials to a centralized knowledge base. This empowers the chatbot to provide accurate, timely responses to student queries. System evaluation showed an average response time of 6.58 seconds, a recognition rate of 95%, and a fallback rate of 5%, demonstrating its efficiency and reliability. EduChat enhances accessibility and productivity in education, presenting significant potential for further development and institutional integration.

Keywords: AI in education; Teacher co-pilot; Chatbot; Natural language processing; EduTech

1. Introduction

The world of education is rapidly evolving to meet the ever-changing demands of students. From the traditional face to face, hybrid, and pure online are options of modes where students could learn. This cycle for continuous innovation was strengthened due to the advent of Artificial Intelligence (AI). It revolutionizes education by offering personalized learning experiences, intelligent tutoring systems, and administrative automation [44]. grading assignments, customizing curriculum content, and improving overall teaching quality [7] are one of the many applications of A.I. in education. In recent years, one of the most groundbreaking developments is the emergence of "teacher co-pilots." This innovative concept represents a collaborative partnership between teachers and technology to elevate the learning experience. At its core, teacher co-pilots integrate traditional teaching techniques with cutting-edge technology to deliver highly engaging and customized educational journeys for students. Artificial guidance systems like chatbots have been extensively utilized in industries like business and healthcare [18]. However, their application in education has only recently been explored. This shift provides new opportunities and benefits, including automating repetitive tasks for teachers, such as answering student queries, retrieving learning materials, and more.

The power of advanced educational technologies like artificial intelligence and machine learning is central to the concept of teacher co-pilots. These systems can help personalize pedagogical strategies to meet the unique needs of individual students. AI-powered chatbots, which leverage Natural Language Processing (NLP), Deep Learning, and Neural Networks, are capable of responding to human queries in a manner resembling a real assistant [22]. NLP enables computers to understand, interpret, and generate human language. In chatbots, NLP facilitates intent classification and response generation, allowing them to provide accurate answers to user queries. Neural Networks, inspired by the structure and function of the human brain, operate through interconnected nodes that process information collectively. These networks adjust weights and biases for connections between nodes, enabling them to learn and make predictions based on input data. Deep learning, a subset of machine learning, trains artificial neural networks with multiple layers

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to identify and extract complex patterns and representations from data. By utilizing hierarchical representations of input data, deep learning enhances chatbots' language understanding and response generation abilities [22].

With these advanced tools, teacher co-pilots can be developed to offer immediate insights into students' progress, learning styles, and areas needing extra attention. This collaborative dynamic underscores the role of technology as a supplement—rather than a replacement—to the critical role of teachers in education [4]. Teacher co-pilots are designed to assist educators by providing real-time responses, resolving doubts, and offering supplementary learning materials. These AI-powered tools analyze student performance, identify areas for improvement, and adapt instructional content accordingly. Beyond facilitating communication between teachers and learners, teacher co-pilots also promote collaborative and team-based learning. They allow educators to focus on innovative teaching methods and increasing student engagement.

One significant advantage of teacher co-pilots is their ability to reduce teachers' workload by automating tasks such as sharing schedules, module content, and additional resources. This enables teachers to concentrate on creating engaging activities and fostering strong relationships with their students. Furthermore, teacher co-pilots support ongoing professional development by providing data-driven feedback on teaching strategies, empowering educators to refine their approaches continually. For students, teacher co-pilots enhance their learning journeys through personalized experiences. These tools offer supplementary resources and alternative explanations, making challenging concepts easier to understand. By providing instant feedback and guidance, teacher co-pilots create a supportive and inclusive learning environment where students can thrive independently. This study designed and developed a model for teachers co-pilot to assist students in the teaching and learning process and to cater to the students' queries 24/7. Hopefully this tool has the potential to transform learning environments.

2. Importance of the study

This study is significant in the field of education and technology as it addressed critical challenges faced by educators and students in modern learning environments. By developing EduChat as an AI-powered teacher co-pilot, it may enhance student engagement by providing personalized learning experiences that foster interaction to reduce feelings of isolation. The availability of instant responses and resources encourages active participation in the learning process. For teachers, EduChat offers valuable support by automating repetitive tasks, such as answering frequently asked questions and managing learning materials, enabling educators to focus on innovative teaching strategies and student development. Furthermore, the study bridges educational gaps by leveraging AI-driven tools to address disparities in student-teacher interaction and accessibility to resources, promoting inclusivity. Through analytics and feedback mechanisms, EduChat empowers educators to refine their teaching methods based on real-time data, supporting continuous professional growth. The integration of advanced AI technologies, such as natural language processing and neural networks, highlights the transformative potential of AI in creating adaptive and scalable educational solutions. Additionally, the study opens avenues for future research on the ethical implementation of AI in education, addressing data privacy concerns and enhancing teacher co-pilot functionalities. By addressing these critical areas, the study contributes not only to academic discourse on AI in education but also to practical solutions for enriching teaching and learning experiences across diverse educational settings.

3. Conceptual framework

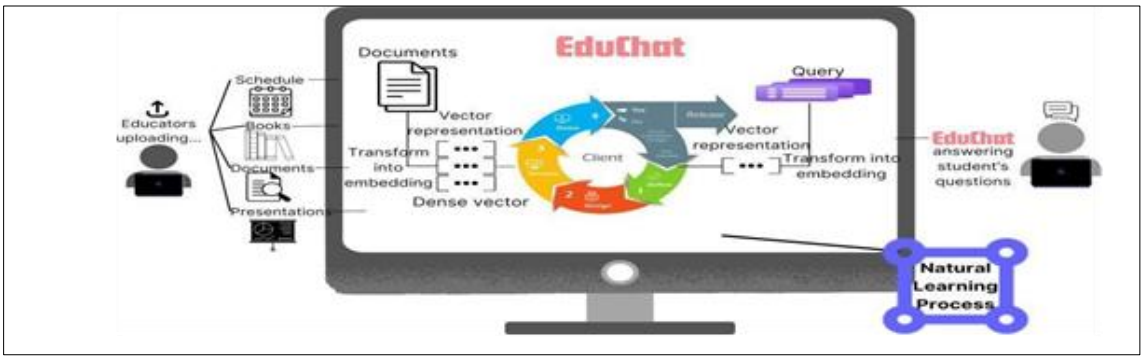

Figure 1 Conceptual Framework

EduChat's framework operates through a vector database system that efficiently stores and retrieves both learning materials and user queries. The process involves two main components: the teacher's side and the user side. On the teacher's side, uploaded learning materials are converted into vector embeddings, which capture semantic relationships and contextual nuances within the knowledge base. On the user side, when a query is submitted, it undergoes a similar transformation into vector embedding. The system then compares these query embeddings with the knowledge base embedding to retrieve relevant information, enabling the chatbot to respond accurately to user queries. This approach aligns with modern Natural Language Processing (NLP) techniques.

4. Research methodology

This study employed a Developmental Descriptive research design to develop and evaluate an educational chatbot systematically. Using agile methodology, the researchers identified gaps in educational chatbot technology and developed a teacher co-pilot model to address student queries using AI platforms. The system underwent security and performance testing for quality assurance, with findings used to guide future improvements and deployment.

5. Software development model

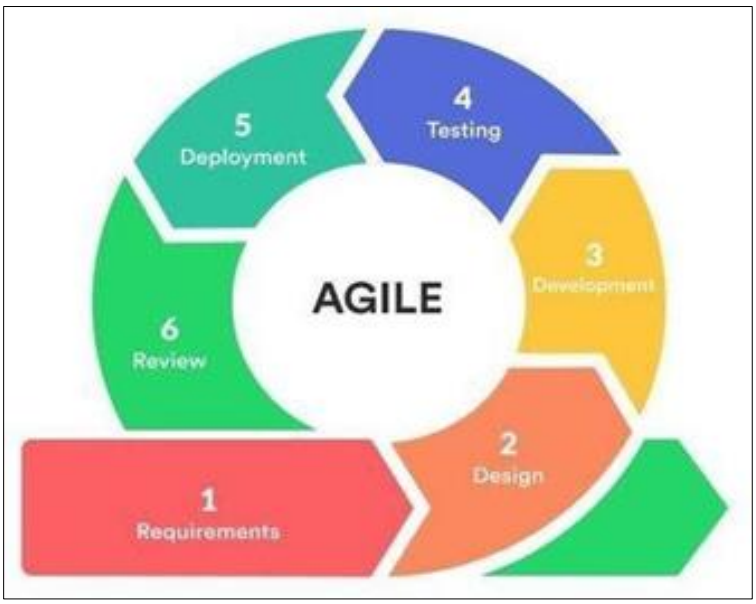

Figure 2 Agile Model

The development of EduChat followed four main phases. In the requirements phase, the researchers gathered academic literature from Google Scholar and prepared necessary hardware and software. The design phase focused on creating user-friendly interfaces for teachers and students, incorporating Centro Escolar University's colors. During the development phase, the researchers built EduChat using Voiceflow platform, implementing LLMs and NLP for core chatbot functionalities. The testing phase evaluated security through Voiceflow analytics and performance through ChatDash metrics, specifically measuring recognition and fallback rates. The system was deployed at Centro Escolar University Manila, allowing teachers to upload learning materials and students to make queries. For reference, the development of EduChat was created using a PC with a Ryzen 5 3600 CPU, 16GB RAM, GTX 1660s GPU, 1TB SSD, and Windows 10. Software including Voiceflow, ChatDash, Visual Studio Code, HTML/CSS, and ChatDash was used for the user interface, development, and coding. For testing the web application, a PC or Cellphone that has a web browser can be used.

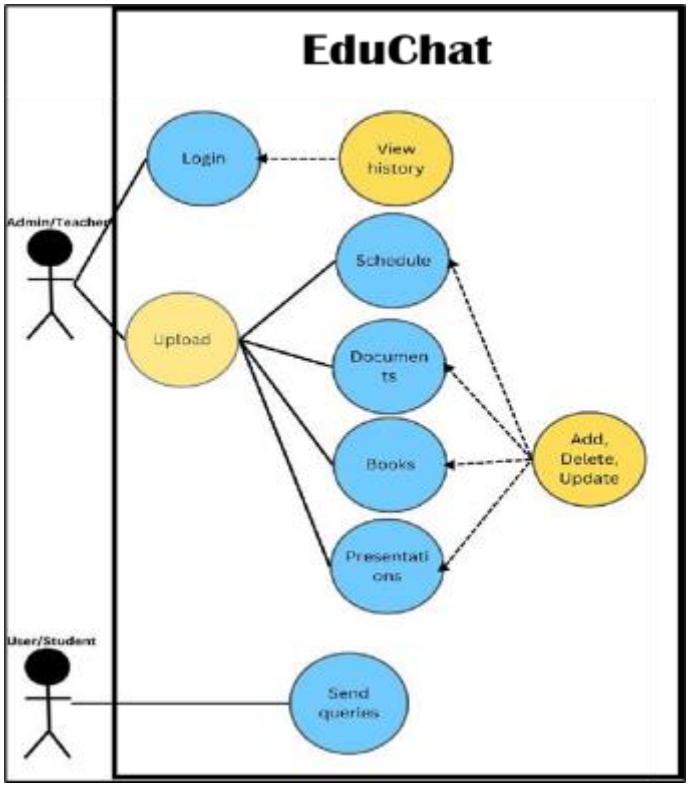

Figure 3 Use Cases

Edu Chat provides distinct functionalities for students and teachers. Students can use the system to inquire about course-related information, including professor schedules, module content, and learning materials, receiving immediate responses derived from the system's knowledge base. On the other hand, teachers after logging in with their credentials, have access to content management features that allow them to upload, delete, and update various learning materials such as schedules, documents, books, and presentations. Additionally, teachers can monitor student engagement through access to analytics and chat history data.

6. Results and discussion

Table 1 Educational Gaps and Their Resolutions

Gap Identified	Supporting Research	Proposed Solution	Implementation in EduChat
Limited student interactivity on educational websites [41]	Supreetha(2022)	Implement chatbots as educational copilots for course-related inquiries	Integrated advanced NLP capabilities with deep learning for improved response accuracy
Time-consuming process of accessing university information [31]	Patel et al. (2019)	Create automated systems for course information delivery	Developed a comprehensive knowledge base system for instant access to schedules and course materials
Reduced student-teacher interaction in online learning [53]	Wu et al. (2020)	Deploy chatbots as teacher assistants to facilitate communication	Implemented user-friendly dashboard for teachers to manage content and monitor student interactions
Inadequate course-specific search capabilities [1]	Abbasi et al. (2019)	Develop special knowledge bases for course content	Created course-specific databases with teacher-uploaded materials for targeted responses

Table 1 explains the gaps found in chatbots in education. Supreetha emphasized integrating chatbots into educational websites to boost student engagement. She recommended the use of tools such as the Rasa framework. Meanwhile, Patel suggested using chatbots as copilots to help students with their questions on topics, thus avoiding the hassle of lengthy visits to universities for information gathering. The importance of chatbots for instructors in sharing course information is highlighted, which could help reduce feelings of loneliness due to minimal student-teacher engagement. Finally, Abbasi and his colleagues emphasize the insufficiency of standard search engines in supplying accurate information, suggesting the creation of subject-specific knowledge repositories within chatbots to enhance students' educational results.

Table 1 provides an in-depth Analysis of the specific characteristics of EduChat's model that target the gaps in education. Supreetha supports the use of chatbots on educational websites, with EduChat bridging this gap by integrating with platforms such as CEU Canvas to improve student interaction. Information retrieval in traditional educational settings is time-consuming, with that, EduChat's centralized repository for subject details and schedules helps to streamline information dissemination. There is a need to enhance student-professor engagement to address feelings of isolation, a problem tackled by EduChat's instant response system created to enable timely and meaningful interactions. Lastly, there are drawbacks in traditional search engines in presenting accurate information, a shortfall addressed by EduChat's capacity to provide personalized answers depending on the educational content shared by educators. Together, these characteristics of the model demonstrated how EduChat could transform educational settings by improving interaction, simplifying access to information, and promoting collaborative learning experiences among students and teachers.

Together, these observations highlight the important function of chatbots as interactive educational aids that can connect information divides, promote teamwork, and improve learning experiences for students and teachers alike. With that, it is a driving factor for the researchers in developing EduChat.

Table 2 Key technological gaps and their resolutions

Technical Challenge	Research Source	Recommended Solution	EduChat Implementation
Limited natural language processing capabilities [2]	Adamopoulou & Moussiades (2020)	Integrate advanced deep learning NLP techniques	Implemented Voiceflow AI with enhanced LLM and NLP capabilities for complex query handling
Poor handling of ambiguous queries[8]	Heller et al. (2019)	Develop robust knowledge base and improved query logic	Created accessible interface for professors to maintain and update knowledge base with real-time analytics
Content management difficulties [12]	Gardner (2019)	Create user-friendly dashboard for content updates	Developed intuitive teacher interface for content management and performance monitoring

Table 2 Highlighted several gaps found in technology. Amapoulou and Moussiades emphasized the limited natural language understanding capabilities, leading to misunderstandings and the inability to answer complex queries. To address this, it is recommended to improve natural language processing (NLP) capabilities by integrating more advanced NLP techniques, including machine learning models for better understanding and responding to students' queries. Another gap is the difficulty in handling unclear queries and providing accurate responses. To overcome this challenge, enhancing the knowledge base and logic of the chatbot, along with implementing a feedback mechanism where teachers can correct and improve the chatbot's responses over time, is suggested.

Lastly, Gardner emphasized the difficulty in maintaining and updating chatbot content and responses are highlighted. To solve this issue, implementing a content management system or knowledge base that allows teachers to easily update and manage chatbot content without requiring technical expertise is recomm

Table 4 provided an in-depth analysis of the specific characteristics of EduChat's model that target the gaps in Technology. There are studies that address the issue of limited natural language understanding capabilities, leading to misunderstanding and the inability to answer complex queries. [2,12]. Educhat utilizes ChatDash and Voiceflow AI, with Voiceflow AI known for its strong collaboration tools that promote teamwork and effective project management. Second, the difficulty in handling unclear queries and providing accurate responses is addressed. Educhat can be easily accessed by professors, facilitating quick and efficient communication.

Lastly, Gardner [12] emphasized the challenge of maintaining and updating chatbot content and responses. In Educhat, teachers can easily update and manage content using ChatDash, which provides a friendly UI for effortless navigation and platform utilization.

Table 3 Hardware Specifications Used During Development

Parts	Hardware 1 (PC)	Hardware 2 (Laptop)	Hardware 3 (PC)	Hardware 4 (Laptop)
CPU	AMD Ryzen 5 3600	Intel i5-11400H	AMD Ryzen 5 3400G	Intel i5-2520M
RAM	16GB DDR4 3200MHz	16GB DDR4 3200MHz	16GB DDR4 3000MHz	4GB DDR3 1600MHz
GPU	NVIDIA GTX 1660S	NVIDIA GTX 1650	AMD Vega 11 (Integrated)	Intel HD Graphics 3000
Storage	1TB M.2 SSD	512GB SSD	256GB SSD	256GB HDD

The researchers tested four devices (2PCs and 3 laptops) in order to find the specs that are recommended for the software. For the CPU, it is recommended to use at least a quad-core processor to ensure smooth performance (at least Intel Core I5 or Amd Ryzen 5) since the CPU is responsible for running the IDE, compiling code, and executing scripts. For the GPU, it is recommended to use a GPU that at least has CUDA support (Compute Unified Device Architecture), especially if machine learning and deep learning techniques will be incorporated in the chatbot. At least Nvidia GTX 1050 or AMD RX 560 is advisable. The RAM is important for multitasking and running applications simultaneously. At least 8GB or more is recommended, depending on the amounts of datasets, the resources required by the development tools, and the testing environments that will be used. For the Storage, an SSD is recommended for faster loading times, smoother running of the software, and smoother software performance [42]. Take note that the recommended specs are only an approximation and will vary depending on the user's requirements. Specs that are lower than the recommended will also run the software but with the possible expense of performance and efficiency. From the test conducted, the recommended specs are I5 or Ryzen 5, GTX1050 or RX 560, 8GB RAM, and SSD storage.

Table 4 Comparison of AI Development Platforms

Platform	Advantages	Limitations
Cody AI	• User-friendly interface for non-technical users • Seamless cross-platform integration	• Limited customization options • Unreliable response accuracy
Flowise AI	• Versatile functionality • Multi-channel deployment support • Multiple LLM options	• Steep learning curve • Premium features are costly • Unstable online deployment
Voiceflow	• Robust collaboration tools • Active community support • Extensive platform integration • Efficient text processing • Cost-effective pricing	• Complex interface navigation • Challenging advanced design features • Programming knowledge required for advanced features
DialogFlow	• Superior natural language understanding • Cross-platform deployment • Comprehensive feature set	• High cost • Complex interface with steep learning curve

Table 4 shows the assessment of various chatbot creation platforms, Voiceflow AI was selected as the best option for developing EduChat, a chatbot tailored for educators and learners. Voiceflow AI is known for its strong collaboration tools that promote teamwork and effective project management, alongside a supportive community that offers valuable resources and a wide range of customization options. The advanced capabilities of the product make it accessible to many users due to its reasonable price.Furthermore, Voiceflow's capacity to connect with different platforms and efficiently handle extensive amounts of text data improves its performance. Thus, in development the researchers used Voiceflow AI to develop EduChat.

Table 5 Comparison of AI Development Platforms

Platform	Key Features	Limitations
ChatDash	• Multi-channel deployment capabilities • Comprehensive analytics and reporting • Secure account management • Extensive knowledge base access • Intuitive user interface	• Limited advanced functionality • Restricted third-party integrations
Bootstrap	• Pre-built responsive components • Adaptable grid system • High customization flexibility	• Significant learning curve • Generic default appearance

Table 5 showed the assessment of platforms that can be used to create the interface for teachers. ChatDash stands out by offering a variety of deployment options across multiple channels, resulting in extensive reach and ease of use. The easy-to-use interface, along with in-depth analytics and reporting capabilities, provides a simple and valuable way to track performance. This will allow a tailored dashboard for teachers to use in displaying information that will help in monitoring students' learning which will allow teachers to have an idea on what to improve based on their students' needs [47].

Nonetheless, even if ChatDash may not have as many advanced features as Voiceflow, the researchers used ChatDash to create the interface for teachers. Both platforms were chosen for EduChat based on their ability to meet the specific needs and goals, ensuring a balance of functionality.

Table 6 Student Interface Platforms

Platform	Pros	Cons
HTML & CSS	It is beginner-friendly, making it easy to learn and ideal for novices.	Achieving consistent styling across browsers can be challenging, leading to cross-browser compatibility issues.
	It offers versatility by working seamlessly across browsers and integrating with tools like Voiceflow AI.	Overusing nested or conflicting selectors can cause specificity issues, resulting in styling errors.
	Accessibility is ensured through proper semantic markup, which guarantees compatibility with assistive technologies.	
	Clean and organized HTML enhances SEO optimization, improving visibility in search engine rankings.	
Angular	Its modular architecture is ideal for building scalable and maintainable large applications.	It has a steep learning curve, requiring significant time and effort to understand its advanced concepts.
	The system provides comprehensive features, including robust tools for dependency injection, testing, and component reuse.	

Table 6 showed the assessment of platforms that can be used to create the interface for students. The researchers have chosen to use HTML & CSS with Voiceflow AI for the frontend integration. HTML & CSS come with numerous benefits, one of which is their simplicity, making it easier to customize the web application to our specific needs. Their adaptability allows them to work smoothly with Voiceflow AI by being compatible with different browsers and platforms. Designing using HTML and CSS allows you to customize your interface all according to your needs, may it be the content, colors, fonts, and the layout [25]. Moreover, the accessibility functions of HTML allow for the development

of an all- encompassing user interaction. The simplicity, versatility, and accessibility attributes of HTML & CSS are more in line with the goals and needs of EduChat, making them the top choice for our frontend development.

Table 7 Comparison of Operating Systems

Operating System	Pros	Cons
Windows 7	It is known for its stable and reliable performance, which has been achieved through years of updates and bug fixes. It offers extensive software compatibility, allowing most older applications to run smoothly.	It lacks modern features and optimizations that are available in newer operating systems. There are compatibility issues due to limited support for new software and hardware. Security risks are a concern because it no longer receives support or security updates, making it vulnerable to threats.
Windows 10	The system includes built-in security features, such as Windows Defender Antivirus, to provide protection against malware. It is optimized for newer hardware, resulting in improved performance and better resource management.	Users may experience compatibility challenges, including issues with older and newer software, installation failures, and unexpected system changes. The system can be resource-intensive, with background processes and updates significantly impacting performance on low-spec devices.
Windows 11	The enhanced optimization also contributes to better battery life and faster loading times. Its modern design features a visually appealing interface, which enhances the overall user experience.	Strict hardware requirements limit its compatibility with older devices. The new interface might be confusing for users accustomed to older versions, requiring a period of adaptation to become familiar with it.

Table 7 assessed the advantages and disadvantages of utilizing various editions of the Windows operating system, such as Windows 7, Windows 10, and Windows 11. In comparison, Windows 7 is known for its stability, wide range of software compatibility, and reliability after receiving updates for many years. Nonetheless, it lacks new features, encounters compatibility problems with new software and hardware, and is no longer supported, leading to potential security threats. Windows 10 has enhanced performance and built-in security features such as Windows Defender Antivirus; however, it could face compatibility problems, installation issues, and use up a large amount of system resources. On the other hand, Windows 11 offers improved performance, a contemporary design, and better user experience due to enhanced optimization, but it may not be compatible with older devices and may require users to adapt to new hardware requirements and interface changes [35].

Due to the advancements in newer versions and the enhanced security and performance capabilities they provide, Windows 10 or 11 are the best options for the EduChat platform.

Table 8 Security Policy Overview

Category	Type	Pass	Fail
App Security	Annual Penetration Testing	✓	
	Quarterly Vulnerability Scan	✓	
	Vulnerability Management	✓	

	Web Application Firewall	✓	
Data Security	Daily Database Backups	✓	
	Encryption at Rest	✓	
	Security Policy	✓	
	SSL/TLS Enforced	✓	
	System Access Control Policy	✓	
Network Security	Denial of Public SSH	✓	
	Firewalls	✓	
	Logging/Monitoring	✓	
	Malware Detection Software	✓	
Infrastructure Security	Encryption of Web-Based Admin Access	✓	
	Multiple Availability Zones	✓	
	Password Policy	✓	
	Security Patches Automatically Applied	✓	

VoiceflowAI followed strict security protocols to protect data exchanged between professors and students, in accordance with global standards and regulations. Primarily, the system adopts an Information Security Management System (ISMS) based on ISO/IEC 27001:2013, offering an organized structure for handling information risks. Furthermore, VoiceflowAI is currently SOC-2 Type 1 compliant and making efforts to attain SOC-2 Type 2 compliance. This guaranteed the security, availability, and confidentiality of the platform with constant monitoring by Drata. Additionally, the platform adheres to GDPR regulations to ensure personal data is handled and protected properly according to European laws. This is reinforced by advanced user permission settings to prevent unauthorized access and misuse of data. Together, these strong security measures showed VoiceflowAI's dedication to creating a safe and reliable space for educational conversations. This ensures the confidentiality, availability, and data privacy of information [11].

Table 9 Response Time

Type	**User Queries (frequency)**	**Average Response Time**
Short	336	5 seconds
Long	448	8 seconds
Fallback	41	4 seconds
Average: 6.58 seconds		

The data in the table showed the time it took to respond to various numbers of user queries We categorized them as short responses (1-5 sentences), long responses (6 sentences above), and fallback responses (such as "I apologize, I can't provide you answers outside my knowledge base"): 336 queries took 5 seconds (short) on average; 448 queries had a response time of 8 seconds (long) and 41 queries resulted in 4 seconds (fallback). The mean time taken for responses in all the tests was found to be 6.58 seconds. These results suggest that EduChat's response time remains stable regardless of the amount of user questions, showing the chatbot's effective performance. Nevertheless, response time of people as well as chatbots affects people's impression [14]. A short response time is perceived as a lack of thought and cognitive effort while a long response time is perceived as an indication of deception. This is supported by an experiment that categorized a chatbot response that took 1-2 seconds only is classified as too fast and a chatbot response that took 10 seconds and beyond was classified as too slow.

Table 10 Fall Back Rate

Total User Queries	Fallback
825	41
Fallback percentage	5%

Fall Back in this context refers to the times in which a chatbot fails to accurately identify and classify what the user is asking or saying and resorts to a fallback response. It is used as an alternative response for chatbots if they are unable to meet a user request or query [50]. The data from the table shows that among 825 user queries, the chatbot used fallback responses in 41 instances. This is equivalent to a fallback rate of 5%. The information shows that EduChat has a low fallback rate, which implies that it consistently performs well in comprehending and answering user queries. Ensuring reliability is crucial in upholding.

Table 11 Recognition Rate

Total User Queries	Recognized
825	784
Recognition Percentage	95%

Recognition in this context is the ability of a chatbot to accurately identify and classify what the user is asking or saying and is able to provide a relevant answer. When a user question is understood, the chatbot retrieves information from the knowledge base. After which, a human-like response will be given to the user based on the information from the knowledge base using Natural Language Generation [2].

Based on the table given, the chatbot accurately identified and answered 784 out of a total of 825 user queries. This leads to a 95% recognition rate. The impressive recognition rate shows that EduChat has a strong ability to comprehend user inputs, which is essential for offering appropriate and informative responses. The chatbot's effectiveness and reliability in educational settings are improved by its high level of accuracy.

7. Conclusion

The researchers were able to meet the study's objective, which is to design and develop EduChat, a model as teacher's co-pilot to assist students in the teaching and learning process and to cater student's queries 24/7. Gaps in the related studies of chatbots in education and teaching and learning process were found and addressed. The researchers were able to utilize available technologies such as Voiceflow, ChatDash, and HTML & CSS in the development of EduChat. In the evaluation of EduChat, Average response time was 6.58 seconds, recognition rate is at 95% and the fallback rate is only 5%. Findings show that EduChat provides immediate answers to questions, guaranteeing that essential information can be accessed easily by students no matter what the time is. In the future, there is still plenty of opportunity for more improvement and growth. The results of this research emphasize the transformative capabilities of EduChat, confirming its importance in improving accessibility, productivity, and involvement in education Youtube link for the Chatbot : https://youtu.be/1lk-8VE6kGI?si=MuW_DqHWyimzPiQu

Recommendations

- Evaluation of EduChat using survey questionnaire in line with the ISO/IEC 25010
- Inclusion/additional functions like multimedia assistance, enhanced data analysis, and even voice recognition.
- Integration with education administration systems, such as canvas.
- Provide a feature to categorize the subject folder.
- Integrate multiple subjects per teacher
- Analytics per subject.
- Provide a link on where the answers were taken from (ie. Pdf title and page)
- Multiple projects for each user profile/teacher

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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