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Empowering Education by Developing and Evaluating Generative AI-Powered Tutoring System for Enhanced Student Learning

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Abstract

Personalized learning has always been a dream for schools, educators, and students but until recently, educators didn't have the time or resources to implement it on a large scale. With the advancements in AI, Generative AI can automate many of a teacher's core tasks, such as creating lesson resources. providing lesson structures and key talking points, designing infographics, creating slideshows, and converting text into videos and images. This study details the development and evaluation of an AI-powered tutoring system designed to enhance student learning experiences. Motivated by the transformative potential of AI in education, the research aims to utilize large language models, including OpenAI, to create a personalized and adaptive learning environment. The research is a two-phase approach, involving a comprehensive literature review, problem definition, and AI integration in the Research Phase, followed by design, prototyping, and testing in the Design and Development Phase. The course creation workflow emphasizes the collaborative efforts of human tutors and AI algorithms using the GPT-3.5-Turbo model. The study identified the potential improvement in education where the course has been created by AI including the image generated by DALLE-3 and contributing to the evolving landscape of AI-assisted education using the text-to-voice, an

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automatic speech recognition system by Whisper, offering an innovative and transformative learning experience for students and tutors. The course content has question-answering chatbots where the students can ask any questions related to the topic while learning.

Keywords: AI-powered tutoring, large language models (LLMs), personalized learning, adaptive interactions, OpenAI Models, Generative AI.

1. Introduction

Based on a market research report from Zion Market Research (Globe Newswire, 2023), the analysis of the size and revenue share of the Global Higher Education Market indicates a value of approximately USD 95.19 billion in 2022. The market is projected to reach around USD 210.06 billion by 2030, exhibiting a Compound Annual Growth Rate (CAGR) of approximately 10.4% during the period from 2023 to 2030. In the contemporary educational landscape, the integration of artificial intelligence (AI) has emerged as a transformative force, redefining traditional teaching methodologies, and enhancing the quality of learning experiences. AI, a branch of computer science that seeks to create intelligent machines capable of performing tasks that typically require human intelligence, holds immense potential to revolutionize education. AI encompasses a diverse set of technologies and algorithms designed to replicate human intelligence, enabling machines to learn, reason, and make decisions. Machine learning, a subset of AI, empowers systems to improve their performance over time without explicit programming. Natural Language Processing (NLP) enables machines to comprehend and respond to human language, while computer vision facilitates the interpretation of visual information. These components collectively contribute to the development of intelligent systems that can engage students in human interaction behaviors. Because of the wide range of applications such as the capacity to generate huge data, content summarization, answer questions, generate images, and so on, it is famous among students, professionals, developers, and educators. But sometimes, these tools can give wrong information, so users need to double-check before using them for serious things. AI tools assist in various areas by speeding up process and making tasks easier, For e.g. they can help teachers quickly prepare tests, complete lesson planning, grade students, and create content for mid and final exams.

This study is about how to develop a AI-assisted learning platform for students and educators and understand the research behind the large language models, application programming interfaces(APIs), and the system. AI offers a unique solution to bridge the gap between theory and real-world understanding. The integrated system proposed for this research seeks to utilize AI through voice, chat, images, and potentially videos to deliver tailored explanations and real-world examples, transforming the learning experience into an interactive and dynamic process. In recent years, the integration of artificial intelligence into educational systems has gained significant attention. The emergence of advanced language models, such as OpenAI and Gemini, hourone.ai presents a unique opportunity to revolutionize the traditional tutoring system.

1.1 Context

Since AI is a very powerful technology that has the potential to change the wide areas of traditional teaching, and multiple areas in society. With the evolution of generative AI since 2022, there has been plenty of discussion on Gen AI tools such as OpenAI's GPT (Generative Pretrained Transformer), Microsoft Big, Copilot, Large language models (LLMS), etc. These tools have quickly gained global attention and users are attracted to their capabilities this sector has been recognized and used to advance a range of disciplines. The growing demand for education underscores the necessity for AI-supported learning where smart educational systems provide instructors and learners with tailored instruction and feedback, for individual needs. These systems aim to enhance the overall quality and efficacy of learning through various computer technologies, particularly machine learning (Alam, 2021). Such technologies are deeply rooted in statistical models and cognitive learning theories. To enhance the self-learning capabilities of an artificial intelligence learning system, integrating a learner model is essential. This model is constructed through the examination of data accumulated during the learning process, assessing a student's reasoning and skill levels. Subsequently, a knowledge analysis is performed to evaluate the student's comprehension of the subject matter, linking learning outcomes to various factors such as educational materials, resources, and learning behaviors. The knowledge model generates a comprehensive knowledge structure map that encompasses essential learning resources, including expert knowledge, common learner errors, and misconceptions. Integrating knowledge fields with learner models, the teaching model establishes criteria for accessing information fields, enabling educators to tailor teaching

methods and activities according to individual student needs. As students' progress in their academic journeys, they will be more inclined to exhibit proactive behaviors, seek assistance, and engage positively.

1.2 Aims and Objectives

The research aims

1. To develop and evaluate an AI-powered tutoring system that enhances student learning experiences through personalized and adaptive interactions.
2. To explore the capabilities of advanced language models, including OpenAI and Gemini, in the development of an AI-powered tutoring system.
3. Design and implement a user-friendly web interface and Learning Management System (LMS) for both students and tutors.

2. Literature Review

2.1 Literature Survey

This study (Zhang & Aslan, 2021) presented a comprehensive examination of empirical studies on Artificial Intelligence in Education (AIED) published between 1993 and 2020. The review encompasses various methodologies, including bibliometrics, content analysis, and categorical meta-trends analysis, to explore the landscape of AIED research, technologies, applications, and their educational implications. It identified 40 studies meeting specific criteria and employs multiple methods to analyze their content and trends which have been categorized into several domains, including chatbots, expert systems, intelligent tutors/agents, machine learning, personalized learning systems/environment, and visualizations/virtual learning environments. The field of adaptive learning environments and knowledge assessment draws insights from this research (Sein Minn, 2022). The study delves into the dynamic landscape of online learning, propelled by the availability of MOOCs and Intelligent Tutoring Systems (ITS). Of particular interest is the application of Artificial Intelligence (AI) techniques in educational settings to deliver personalized and adaptive learning content. The study reviewed the development of prominent families of student models, and psychometric theory from early educational research with contemporary adaptations utilizing machine learning and deep

learning techniques. The findings include the unexpected dominance of IRT (Item Response Theory) models, the importance of considering learning transfer across skills, and the challenges posed by recent neural network-based student models. The integration of Artificial Intelligence (AI) technology settings has become a focal point for enhancing learning experiences. This study investigated college student's Willingness to Accept (WTA) AI-assisted learning environments, a crucial yet often overlooked aspect of technology adoption in higher education. Grounded in the Unified Theory of Acceptance and Use of Technology (UTAUT) and the theory of perceived risk, the research identifies six influential factors affecting student's WTA. These factors include Performance Expectancy (PE), Effort Expectancy (EE), Social Influence (SI), and three dimensions of perceived risk (Functional Risk, Psychological Risk, and Social Risk). The study reveals a 'weak rejection' among college students regarding the construction of AI-assisted learning environments. Notably, PE, EE, and SI exhibit positive correlations with WTA, emphasizing the significance of perceived benefits and ease of use (Wu et al., 2022). Conversely, Psychological Risk (PR) significantly negatively influences students' WTA.

The author introduced the role of a Prompt Engineer in the context of AI-powered systems, particularly large language models (Sunil Ramlochan, 2023). It emphasizes the importance of prompt engineers in ensuring the relevance, accuracy, and desired outcomes of AI-generated responses. The article (Compilatio, 2023) discussed the multifaceted applications of AI in education, positioning AI as a dynamic tool that benefits both educators and students. It emphasizes AI's role in personalizing learning experiences through platforms like Zelexio and adaptive learning paths on platforms such as Khan Academy. Additionally, AI streamlines administrative tasks with tools like timetabling software and automates the assessment of assignments through systems like Compilatio Magister and e-Rater. It also highlighted AI's support for daily tasks, including grammatical correction and speech recognition for notetaking. Further, it explored immersive learning through AR and VR technologies, exemplified by the University, and the creation of simulations for practical understanding. Collaborative tools like Google Drive and plagiarism detection tools underscore AI's pivotal role in enhancing collaboration and maintaining academic integrity in the educational landscape. The study (Ganesan et al., 2023) explored the integration of Artificial Intelligence (AI) in education through the development of Intelligent Tutoring Systems (ITS)

in computing. They highlighted the limitations of traditional Computer-Assisted Instruction (CAI) packages in engaging users actively and guiding problem-solving, advocating for the more dynamic and personalized approach offered by ITS. The research underscores the potential of ITS to transform computer-assisted instruction and calls for continued exploration and refinement in integrating AI into educational practices. (McIntosh et al., 2023) presented an insightful survey investigating the shifting landscape of generative Artificial Intelligence (AI), particularly highlighting the transformative impacts of innovations like Mixture of Experts (MoE), multimodal learning, and the speculated advancements toward Artificial General Intelligence (AGI). The study critically evaluates advancements such as Google Gemini and the anticipated OpenAI Q* project, discussing their profound influence on research agendas and applications across diverse domains including healthcare, finance, and education. Through a comprehensive examination of model architectures, including Transformer Models and Recurrent Neural Networks (RNNs), the authors underscore the significance of these developments in revolutionizing AI, especially in Natural Language Processing (NLP) and computer vision domains. The study also addresses computational challenges, scalability issues, and real-world implications associated with emerging academic challenges in AI-themed and AI-generated preprints. Furthermore, it discussed the evolution of technologies such as OpenAI and Gemini, providing insights into the timeline of key developments in language model evolution.

This study explored the question of whether robots should replace teachers, focusing on the mobilization of Artificial Intelligence (AI) and Learning Analytics in education. The author discussed how AI platforms enable instructors to enhance the quality of instruction and increase efficiency in administrative tasks like evaluating student work. By leveraging machine learning and adaptability, these systems can customize curriculum and materials to meet individual student needs, leading to improved absorption, retention, and overall learning experiences. The study (Alam, 2021) aims to evaluate the impact of AI on educational possibilities through a qualitative research approach, examining its effects on administrative, pedagogical, and learning aspects. Through a literature review, the study highlighted AI's integration into educational institutions through computers, web-based platforms, and robots, emphasizing its role in enhancing teaching efficiency and personalizing learning experiences. (Wei Cui Zhen Xue and Khanh-Phuong Thai, 2018) conducted a study evaluating the

performance of an AI-based adaptive learning system, 'Yixue Squirrel AI,' in the context of English and math education for middle school students in China.

The realm of generative AI tools, such as OpenAI's GPT and Google Bard, focuses on the potential applications in developing assessments for Massive Open Online Courses (MOOCs) found in this study (Rai et al., 2023). The researchers aimed to explore the capabilities of generative AI in creating various types of assessments suitable for MOOC environments. While acknowledging that not all MOOC-style assessments can currently be generated, the authors highlight the promise of emerging AI tools for broader support in the future. In the research (Banjade, 2023), they have explored about the use of LLM models utilizing the API of GPT -3 and GPT 3.5 Turbo for the study of content generation to enhance writing by providing suggestions and improving readability. It supports various content types based on the given prompt. The demonstration on the pdf summarizer by building customized chatbots for document summarization and question answering using large language models using a framework with open AI, Langchain and Streamlit has been implemented as well (Sangita Pokhrel, 2024)

In their study, (Yang et al., 2023) highlighted the significance of extracting API comparison knowledge from texts, particularly in software engineering tasks, where current methods often require extensive manual effort and struggle with language complexities. To address this challenge, the research introduced APICKnow, a novel language model designed to efficiently extract subtle differences between APIs from software engineering texts. APICKnow approached the task of extracting API comparison knowledge as a sequence-to-sequence generation problem, leveraging a large pre-trained language model. Notably, the model can simultaneously identify API entities and their relations, providing a comprehensive understanding of API interactions.

3. Methodology

3.1 Research Phase

In this initial Research Phase, a comprehensive literature review has been conducted to understand the current landscape of educational AI models. This will be complemented by an in-depth analysis of existing AI-driven educational platforms, identifying key trends,

challenges, and opportunities. Simultaneously, the problem definition stage will focus on identifying educational gaps through a meticulous process, including user needs assessments. This phase lays the foundation for informed decision-making in subsequent stages. The Figure 1 shows the proposed methodology.

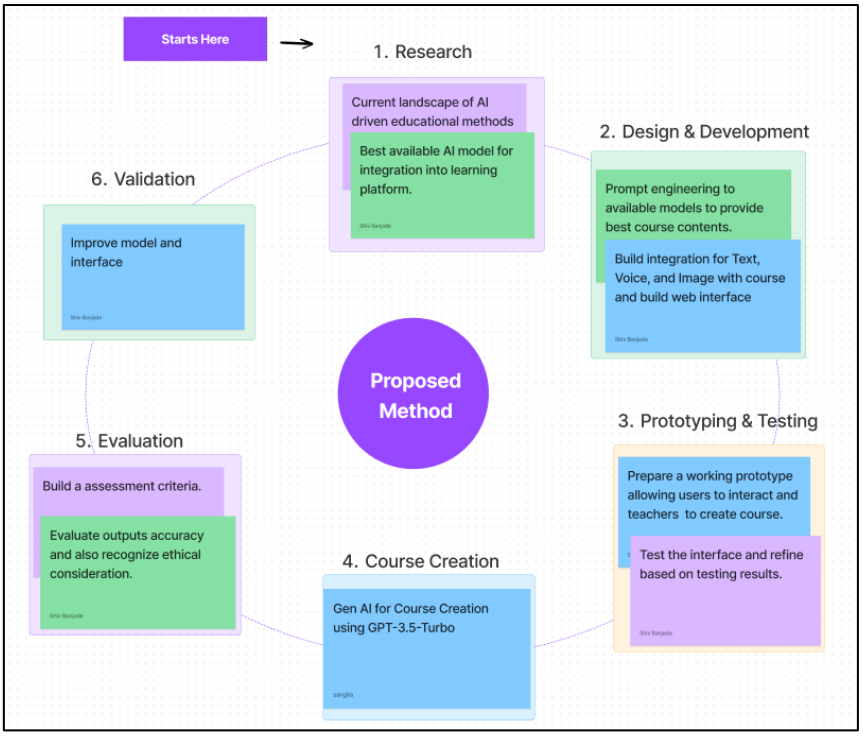

Figure 1. Proposed Methodology

3.1.1 Course Creation

In the course development phase, the collaborative efforts of human tutors and AI capabilities converge to shape a distinctive learning experience. Human tutors are well-versed in their respective domains, while AI algorithms dynamically generate interactive course content. This cooperative approach aims to provide a tailored and adaptive learning journey for each student, without the reliance on external AI experts. The fusion of human expertise and AI dynamism seeks to redefine traditional education, offering students a personalized and responsive educational path. The Figure 2 illustrates the course creation window.

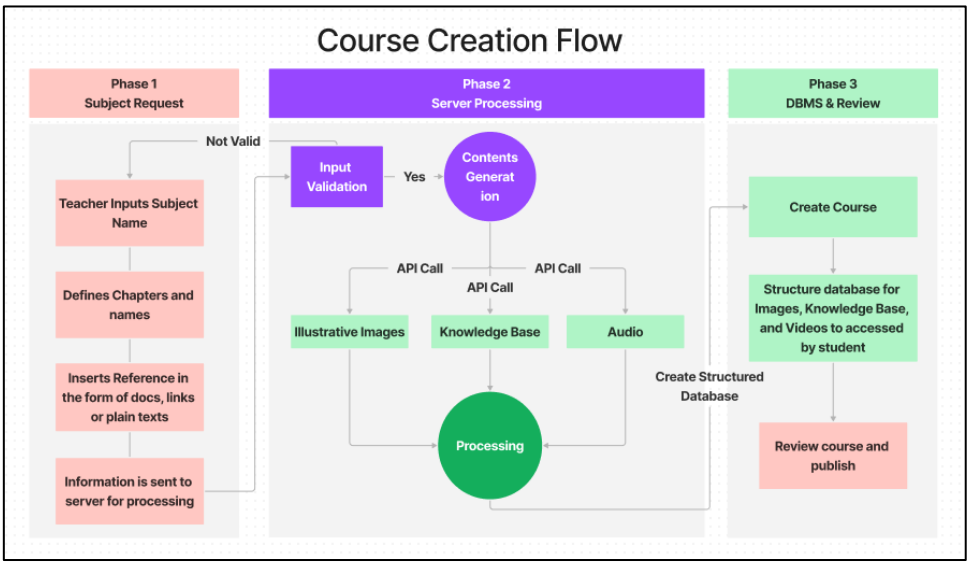

Figure 2. Course Creation Workflow

The first phase is the Subject Request where the teacher inputs the subject name and defines the chapters and names for the course. The system then validates the input to make sure it is valid. If the input is not valid, the system returns an error message, and the teacher must correct the input. If the input is valid, the system moves on to the Server Processing phase where the system generates the contents of the course, including the text, images, and videos. The system makes an API call to a content generation service based on the prompt provided by the teacher in the first phase. It also creates a structured database for storing all of the course materials. Once the course materials have been generated, the system moves on to the DBMS and Review phase. In this phase, the course is reviewed and published once the tutor reviews the content and is satisfied with it. The teacher can also insert references in the form of documents, links, or plain text.

3.2 Research Strategy and Approach

The impact of artificial intelligence (AI) on education, particularly focusing on generative AI, Chatbots, analytics, and personalized learning experiences has been studied and experimented rapidly. After the release of ChatGPT in 2021, it has been used by students and teachers for student support, adaptive assessment, personalized learning, and predictive analytics. To ensure the responsible and ethical use of AI in education, recommendations are given for future research, policy creation, and professional development programs.

Collaboration among researchers, educators, and policymakers is emphasized to maximize the benefits of AI while mitigating risks and challenges in educational settings.

A significant turning point in the AI industry has been reached with the development of generative AI, which is characterized by its focus on ethical and interconnected systems as well as the creation of advanced models like the Gemini and MoE. Artificial Intelligence (AI) systems have the potential to transform a multitude of industries due to the growing ability to replicate human-like responses and problem-solving skills. These developments respect moral principles while providing creative answers. Businesses now have a great chance to take advantage of these developments and stay at the forefront of technical innovation.

Research in the field of artificial intelligence (AI) is conducted in several areas and subdomains, with a focus on new trends, AGI development, compliance, ethical issues, advanced learning, human value alignment, and model architecture. The model architecture combines transformer structures, mixing of experts, recurrent neural networks (RNN), and multimodal models to improve scalability and efficiency. Training methods include reinforcement learning, transfer learning, and both supervised and unsupervised learning.

In the research, Transformer structures were employed for efficient text processing and multimodal systems, such as DALLE-3, to integrate text and image data. Natural Language Processing (NLP) models like GPT-3.5-turbo were utilized for tasks involving text understanding and conversational AI. Additionally, Conversational and Creative AI was applied to enhance educational content creation. The training methods including supervised learning for generating course content and advanced techniques can also be customized using prompt engineering techniques.

3.3 Large Language Models

Humans have created spoken languages to communicate with one another throughout history. All forms of human and technological communication rely on language since it provides the words, meanings, and conventions required to convey ideas and concepts. Language models have a similar function in the field of artificial intelligence (AI), facilitating communication and the generation of novel concepts (Sean Michael Kerner, 2023)

The most popular architecture for large language models is the transformer model. It consists of a decoder and an encoder. To handle data, the transformer model divides the input into tokens. These tokens are then subjected to mathematical operations to determine their relationships. Because of this, the computer can recognize patterns in the data in a way that is comparable to how a human would. The system works with the prompt of the user, where the transformer model serves as the backbone for the natural language processing tasks. The user prompt goes as input and generated content using the Transformer model can encompass a wide range of tasks such as content generation, text summarization, or any form of textual content. If the user finds the content satisfactory, they will use it, if not, the user revises the prompt or provides additional input, and the model incorporates the user feedback to rerun the model to generate new content or responses. Figure 3 shows the framework of the transformer model and its use cases.

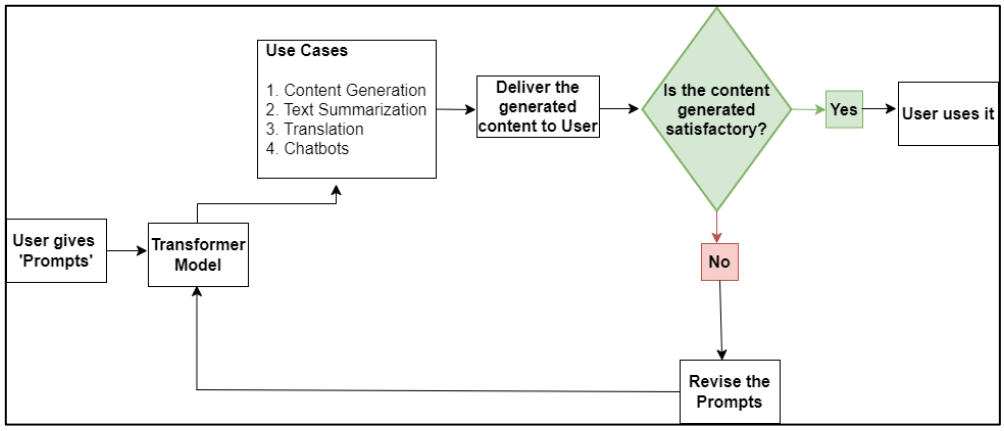

Figure 3. Framework on the Transformer Model and its Use Cases

The framework involves a process where the user first provides prompts to a Transformer Model, which is used for tasks such as content generation, text summarization, and more. The model then delivers the generated content back to the user. If the user finds the output satisfactory, they proceed to use it. However, if the content is unsatisfactory, the user revises the prompt and resubmits it to the Transformer Model, repeating this cycle until the desired output is achieved.

3.3.1 Generative AI

Generative AI refers to models or algorithms that use a large, pre-trained dataset to generate fresh output, such as text, images, videos, code, data, or 3D renderings. These algorithms can produce fresh information and make predictions by expanding their training set. The foundation models (big AI models) that drive general artificial intelligence (Gen AI) are capable of multitasking and executing a wide range of unconventional tasks, including as classification, Q&A, summarization, and more.

The Table 1, shows the type, applications, and the application level of the Generative Ai models and platforms. The proposed method utilized the GPT 3.5, and DALLE-3 for the content generation as well as for the image generation based on the title.

Table 1. Type, Applications and Application Level

Type	Applications	Application Level
Text Generation	GPT-3, GPT-4, GPT Neo	Chatbots, Content Creation, Text Summarization, Translation, Pdf summarizer and reader and so on.
Image/Video Generation	DALLE-2, DALLE-3, Mid Journey, Stable Diffusion	Text to image generation, Art Generation, Deepfakes, Image captioning, Video Synthesis
Speech/Music Generation	Voicebox, Supertone, Loudly	Speech Synthesis, Music Composition, Voice Assistants, Soundtrack Creation, Audio Storytelling
Code Generation	Github, Microsoft, Open AI	Automatic programming, Code completion, Software Development

3.4 Prompt Engineering and Setup

This section outlines the process of configuring and utilizing OpenAI's API for language and image generation models, including ChatGPT, Whisper, and DALLE-3. Specifically, the setup for the GPT-3.5-turbo model, where the system role is designed to limit the chatbot's responses to questions directly related to a specific chapter of a subject is detailed.

The system prompt ensures that the chatbot only provides answers relevant to the chapter text, indicated by a placeholder, thereby maintaining contextual relevance.

For instance, the configuration for GPT-3.5-turbo (Figure 4) is as follows:

Model: gpt-3.5-turbo

Messages: [{

role: system

Content: You are a chatbot included in AI LMS. Users will ask questions about a chapter form the subject. The chapter text includes the following. Only answer the question if the question is related. Chapter Text: <chapter>}

{Role: user

Content: <text>}

Figure 4. Configuration for GPT-3.5-Turbo

Prompt engineering, a key aspect of this process, involves guiding AI models to produce desired outputs through well-structured input. For generating chapter titles, the following prompt (Figure 5) is used:

{"model": "gpt-3.5-turbo-instruct-0914",

"prompt": "You are an online course platform. Generate <chapter> chapters for <topic> as following order 1. 2. 3. 4. 5. And so on. Strictly only mention chapter names, no explanations needed."}

Figure 5. Prompt Used

This prompt directs the GPT-3.5-turbo-instruct-0914 model to create a sequential list of chapter titles for a given topic, focusing solely on producing chapter names without additional explanations. This approach ensures outputs are concise and organized. Through ongoing prompt engineering and fine-tuning, the models can be customized to meet specific educational needs and enhance the customization of chatbots based on user requirements and knowledge levels.

4. Results and Analysis

Based on the recent market trends, the growing role of the generative AI tools in various industries have been rapidly taking the market. Whether by the marketers in content creation, or to automate content generation in different sectors including the education sector to effectively streamline workflows and reduce the time spent in content creation and idea generation. In this research, Bubble, a full stack no-code app builder platform, was used to create the user interface for high-performing AI-powered apps. The OpenAI API was integrated to utilize the GPT-3.5 Turbo for generating course content, Dalle-3 for generating the cover images, and Whisper API for the text to voice integration.

The system created generates the content with the help of teachers at any level of education.

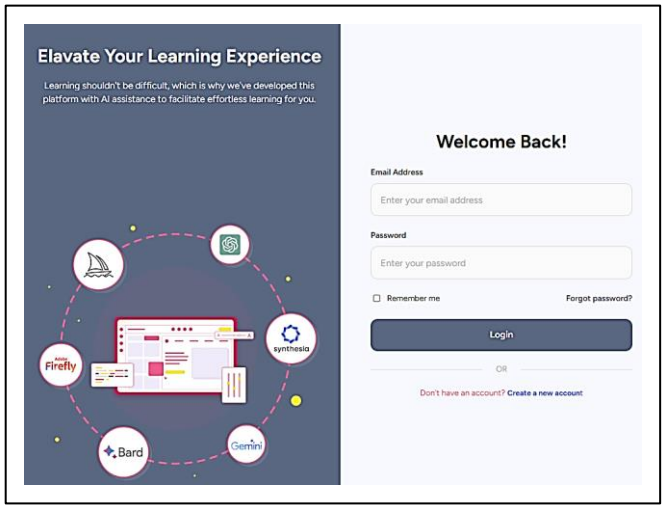

Figure 6. Login Dashboard to Create an Account

The login page is defined as Elevate Your Learning Experience at the University of Wolverhampton as shown in Figure 6. It uses AI to personalize the learning experience, as stated in the platform's explanation. Users can create or log in with their email address and password, and there are options to remember their information or retrieve a forgotten password.

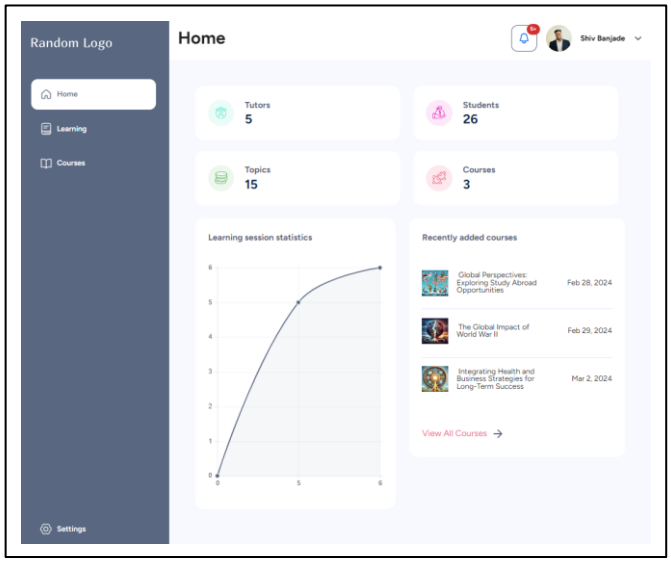

Figure 7. Application Page

Once the user logs in to the page, they go to the application page (Figure 7) which will be different for tutor and students. In the Figure 8, there are three options, one Home, Learning and Courses. In the course section, the tutor or the educator creates the content, lessons, generate the images with respective to the title and updates the AI generated content to make it align to the course which will be available for the student.

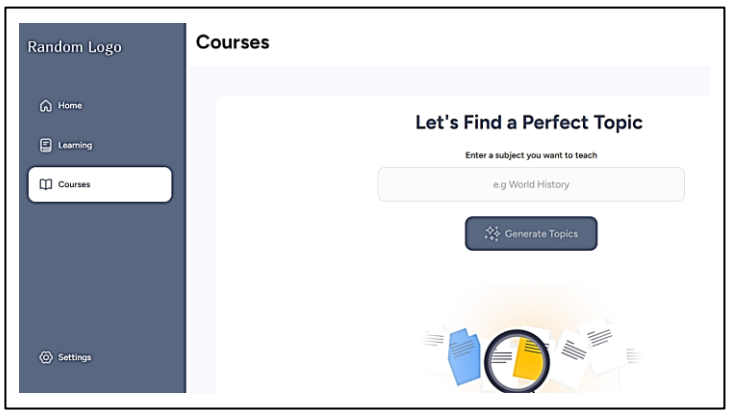

Figure 8. Course Creation Page

In the course creation page, the tutor enters the subject that they would like to teach such as World History, and generates the various options for the topics which will be chosen by the tutor which is seen in Figure 8.

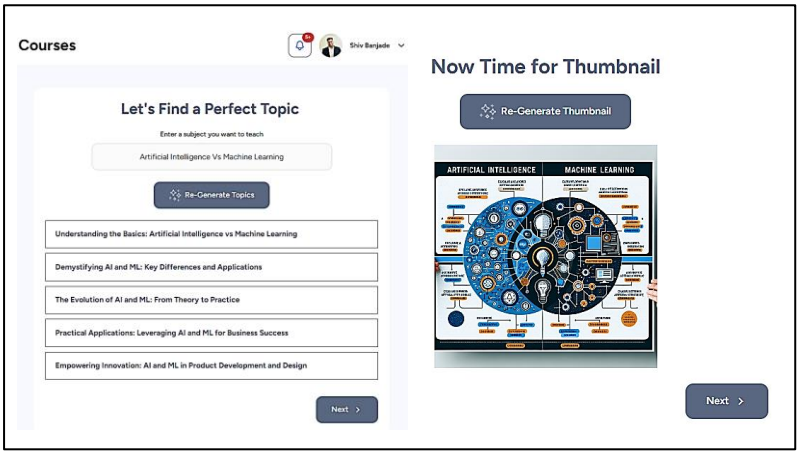

Figure 9. Topic and Thumbnail Generation

Once the system gives the various topics, the tutor will need to choose one and the next step is to generate the thumbnail. In Figure 9, we have entered the subject 'Artificial Intelligent Vs Machine Learning', and 5 different topics have been given. We have chosen the 'Understanding the Basics: Artificial Intelligence vs Machine Learning' and the thumbnail was created based on the selected domain which was successfully done in the backend by using the DALLE-3 which is an image-generated Gen AI application by Open AI. If the tutor is not satisfied with the current image, they can generate another one.

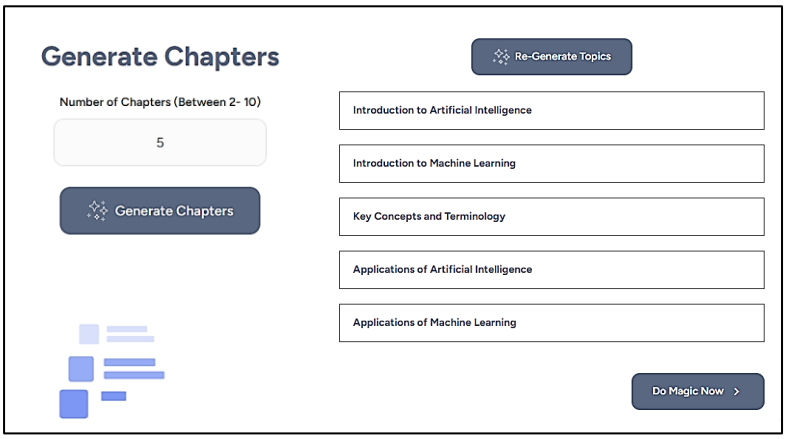

Figure 10. Generating Chapters and Topics for the Course

Now, it's time to generate the chapters as shown in Figure 10, there is an option that the tutor can generate 2-10 chapters for a single topic, here we have selected 5 which can be seen in the attached figure.

The subtopic generated at this stage are based on the title that was selected previously which will align to the subject areas and give the best out of it. The coursework can be reviewed

by the tutor and the necessary changes on addition or removal of a few of the contents inside and it goes to the learning page from where the students can see the course, contents and read it or listen to the voice which has been generated by using the Whisper API along with the Q/A chatbots.

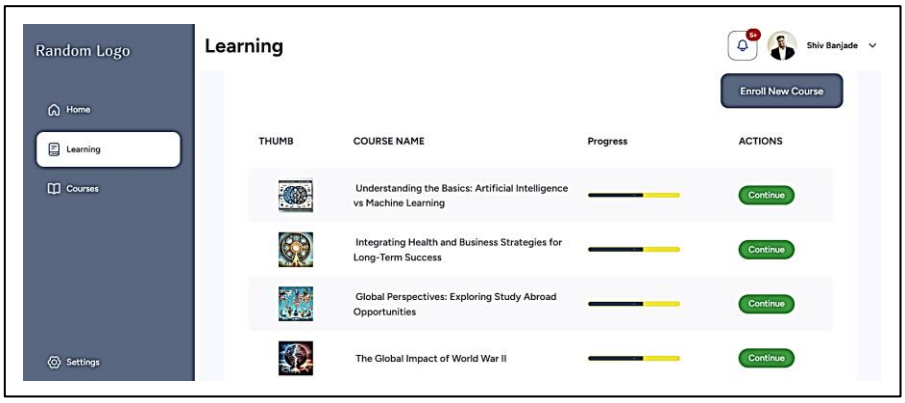

Figure 11. Learning Site for the Students

Figure 11 shows the student learning dashboard facilitating student's access and monitoring of their enrolled courses. Following the creation of the content, courses transition into the learning phase highlighting the exhibiting courses with the completion score. In this prototype, there are four courses and each course listing includes a thumbnail image, the course title, and the progress of the student. The 'Continue' option is likely to resume course activities and the details provide a more comprehensive overview. We can integrate quizzes, questions, and another set of activities for the students to understand their knowledge.

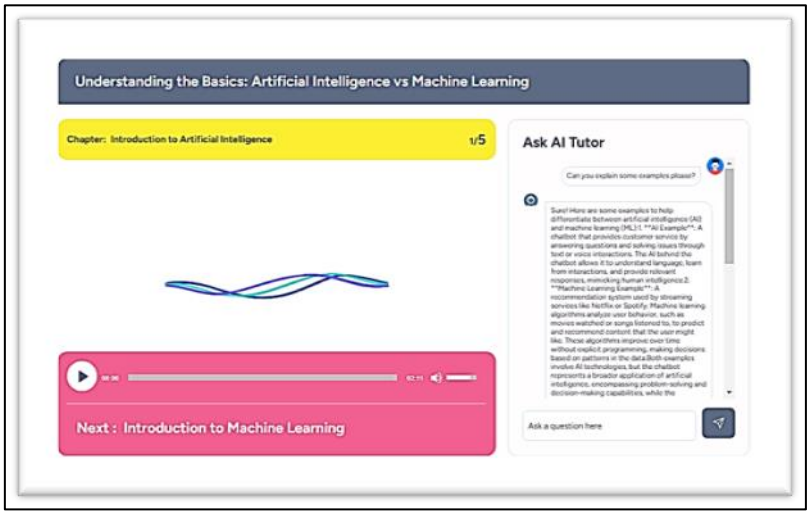

Figure 12. Voice-Activated Learning Along with the Q/A Chatbot

The voice-activated feature has been also implemented in this project for the course generated by the tutor which offers students the option to listen through voice activation as shown in Figure 12. An 'Ask AI Tutor' function allows students to ask questions related to the chapter content. Let's break down the functionalities:

Current Functionalities

Course by Tutor: The course content is designed by the tutor and created by AI, updated by the tutor again.

-**Playback Options:** Students can access the course material in two ways:

- **Audio:** They can listen to the lecture using voice-activated controls, likely implying hands-free operations. The one-chapter content duration is 2 minutes and 11 seconds and can be paused at any time.
- **Text:** The chapters are also available in the text format where students can read it.
- **Ask AI Tutor (Q&A Chatbot):** Students can interact with a question-and-answer chatbot to get more information related to the chapter content. The future version would personalize the student experience by considering the student's knowledge level, subject areas of interest and learning progress.

While talking about challenges, incorporating AI into education presents several challenges and limitations that need to be addressed to improve effectiveness. AI models often struggle with understanding the context and variability of educational content, leading to potential inaccuracies. They may also fall short in providing highly personalized learning experiences tailored to individual needs. Ethical concerns arise from potential biases in AI training data, and ensuring fairness and transparency remains difficult. Additionally, safeguarding data privacy and security is crucial as AI platforms handle extensive student information. Overcoming these issues requires collaboration among educators, technologists, policymakers, and other stakeholders to promote ethical practices, transparency, and privacy, ensuring AI-driven educational tools can enhance teaching and learning effectively.

5. Conclusion

In conclusion, this research demonstrates the transformative potential of artificial intelligence in education through an AI-powered tutoring system. By leveraging smart algorithms, generative AI, and adaptive technology, the system personalizes learning, supports teachers, enhances course creation, and engages students with customized chatbots and interactive visuals. The study emphasizes the importance of integrating AI to meet individual student needs, optimize curriculum delivery, and create an engaging learning environment. The research involved a thorough review of existing AI platforms, user needs assessments, and fine-tuning AI models to improve their performance. The use of OpenAI tools like text-to-text, text-to-image (DALLE-3), and text-to-voice (Whisper) has facilitated the development of a user-friendly system for personalized learning experiences.

However, some of the challenges remain, including limited contextual understanding, lack of customization, ethical and bias concerns, data privacy, and technical accessibility. Addressing these challenges requires collaboration among educators, technologists, policymakers, and stakeholders to promote ethical AI practices and prioritize student privacy and inclusivity. To enhance AI-driven education, incorporating engaging videos and interactive avatars are recommended to make learning more dynamic, developing personalized chatbots for various educational institutions to provide tailored support, and establishing continuous feedback mechanisms to improve the system. Additionally, focusing on ethical AI practices and data privacy will ensure compliance and promote fairness and transparency in educational technologies.

References

[1] Alam, Ashraf. "Should robots replace teachers? Mobilisation of AI and learning analytics in education." In 2021 International Conference on Advances in Computing, Communication, and Control (ICAC3), Mumbai, India, IEEE, 2021. 1-12.

[2] Avrahami, Omri, Thomas Hayes, Oran Gafni, Sonal Gupta, Yaniv Taigman, Devi Parikh, Dani Lischinski, Ohad Fried, and Xi Yin. "Spatext: Spatio-textual representation for controllable image generation." In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition, 2023. Vancouver, BC, Canada, 18370-18380.

[3] Pokhrel, Sangita, and Shiv Raj Banjade. "AI Content Generation Technology based on Open AI Language Model." Journal of Artificial Intelligence and Capsule Networks 5, no. 4 (2023): 534-548.

[4] Compilatio. (2023, August 1). AI as a tool to assist teaching and learning. https://www.compilatio.net/en/blog/ia-assistance-teaching

[5] Department for Education. (2023). Generative AI in education Call for Evidence: summary of responses. https://assets.publishing.service.gov.uk/media/65609be50c7ec8000d95bddd/Generative_AI_call_for_evidence_summary_of_responses.pdf.

[6] Feuerriegel, Stefan, Jochen Hartmann, Christian Janiesch, and Patrick Zschech. "Generative ai." Business & Information Systems Engineering 66, no. 1 (2024): 111-126.

[7] Ganesan, Swathi, Nalinda Somasiri, and Sangita Pokhrel. "The Role of Artificial Intelligence in Education." In 2023 International Conference on Computer Communication and Informatics (ICCCI), Coimbatore, India,IEEE, 2023. 1-6.

[8] Globe Newswire. (2023, September 4). Educational Revolution: Global Higher Education Market Size to Achieve 10.4% CAGR, Reaching $210.06 Billion by 2030. FintechFutures. https://www.fintechfutures.com/techwire/educational-revolution-global-higher-education-market-size-to-achieve-10-4-cagr-reaching-210-06-billion-by-2030/

[9] Göring, Steve, Rakesh Rao Ramachandra Rao, Rasmus Merten, and Alexander Raake. "Analysis of Appeal for realistic AI-generated Photos." Ieee Access 11 (2023): 38999-39012.

[10] Hao, Karen. "China has started a grand experiment in AI education. It could reshape how the world learns." MIT Technology Review 123, no. 1 (2019): 1-9.

[11] McIntosh, Timothy R., Teo Susnjak, Tong Liu, Paul Watters, and Malka N. Halgamuge. "From google gemini to openai q*(q-star): A survey of reshaping the generative artificial intelligence (ai) research landscape." arXiv preprint arXiv:2312.10868 (2023).

[12] Rod Berger. (2021, December 16). Amira Learning CEO Personalizes Artificial Intelligence for Literacy Gains. Forbes. https://www.forbes.com/sites/rodberger/2021/12/16/amira-learning-ceo-personalizes-artificial-intelligence-for-literacy-gains/

[13] Rai, Laxmisha, Chunrao Deng, and Fasheng Liu. "Developing massive open online course style assessments using generative AI tools." In 2023 IEEE 6th International Conference on Electronic Information and Communication Technology (ICEICT), Qingdao, China. IEEE, 2023. 1292-1294.

[14] Pokhrel, Sangita, Swathi Ganesan, Tasnim Akther, and Lakmali Karunarathne. "Building Customized Chatbots for Document Summarization and Question Answering using Large Language Models using a Framework with OpenAI, Lang chain, and Streamlit." Journal of Information Technology and Digital World 6, no. 1 (2024): 70-86.

[15] Sean Michael Kerner. (2023, September). Large language models (LLMs). TechTarget.

[16] Minn, Sein. "AI-assisted knowledge assessment techniques for adaptive learning environments." Computers and Education: Artificial Intelligence 3 (2022): 100050.

[17] Sunil Ramlochan. (2023, April 28). What is a Prompt Engineer: The Developing and Essential Role of Prompt Engineers in AI Powered Systems. Prompt Engineering Institute. https://promptengineering.org/what-is-a-prompt-engineer-the-developing-and-essential-role-of-prompt-engineers-in-ai-powered-systems/

[18] Wang, Shuai, Claire Christensen, Wei Cui, Richard Tong, Louise Yarnall, Linda Shear, and Mingyu Feng. "When adaptive learning is effective learning: comparison of an adaptive learning system to teacher-led instruction." Interactive Learning Environments 31, no. 2 (2023): 793-803.

[19] Cui, Wei, Zhen Xue, and Khanh-Phuong Thai. "Performance comparison of an AI-based adaptive learning system in China." In 2018 Chinese automation congress (CAC), IEEE, 2018. 3170-3175.

[20] Wu, Wentao, Ben Zhang, Shuting Li, and Hehai Liu. "Exploring factors of the willingness to accept AI-assisted learning environments: an empirical investigation based on the UTAUT model and perceived risk theory." Frontiers in Psychology 13 (2022): 870777.

[21] Yang, Yangrui, Yaping Zhu, Sisi Chen, and Pengpeng Jian. "API comparison knowledge extraction via prompt-tuned language model." Journal of Computer Languages 75 (2023): 101200.

[22] Zhang, Ke, and Ayse Begum Aslan. "AI technologies for education: Recent research & future directions." Computers and Education: Artificial Intelligence 2 (2021): 100025.