AI-Based Training and Assessment Tool for Vocational Education System

24-25J-185

Project Final Thesis

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B.Sc. (Hons) in Information Technology

Specializing in Information Technology

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DECLARATION

We declare that this is our own work, and this Thesis does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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11/04/2025

Date

ABSTRACT

In the evolving landscape of vocational education, the demand for personalized, engaging, and scalable training solutions is higher than ever. This research project presents an AI-based training and assessment tool tailored for vocational education with three key components: AI-Viva Session, Gamification, and Skill-Based Personalized Learning Path. These components work collaboratively to modernize how vocational skills are taught, practiced, and assessed.The **AI-Viva Session** is an automated oral assessment system that simulates real viva exams. Using speech recognition and Natural Language Processing (NLP), it evaluates verbal responses in real-time, dynamically generates follow-up questions, and delivers instant feedback. This makes viva exams scalable, unbiased, and accessible—especially in under-resourced training environments.The **Gamification** module introduces interactive 2D game-based learning environments to replace traditional lecture-style instruction. By embedding educational content within puzzles, quizzes, and simulations, learners are exposed to realistic vocational scenarios that enhance engagement, motivation, and skill retention. This method aligns with modern educational psychology and supports hands-on learning in a risk-free setting.The **Skill-Based Personalized Learning Path** uses a pre-assessment quiz and machine learning to classify students into skill levels: Beginner, Intermediate, or Advanced. Based on this classification, the system unlocks a customized path with adaptive content, multilingual support (Tamil, Sinhala, English), and real-time progress tracking. Students receive targeted support where needed and skip redundant content, ensuring efficient and meaningful learning.Collectively, these components address common challenges in vocational training, such as limited instructor availability, low student engagement, and lack of personalized learning. The proposed solution enhances vocational education by improving assessment quality, increasing learner motivation, and delivering adaptive, practical skill development at scale

.**Keywords:** *AI Viva, Automated Oral Assessment, Gamification, Game-Based Learning, Personalized Learning Path, Vocational Education, Speech Recognition, Natural Language Processing, Skill Prediction, Adaptive Learning*

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LIST OF ABBREVIATIONS

Abbreviations	Description
SLIIT	Sri Lanka Institute of Information Technology
NLP	Natural Language Processing
AI	Artificial Intelligence
API	Application Programming Interface
NLTK	Natural Language Toolkit
AES	Automated Essay Scoring
UI	User Interface
XML	Extensible Markup Language
REST	Representational State Transfer
UAT	User Acceptance Testing
HTML	Hyper Text Markup Language
JS	Java Script
CSS	Cascading Style Sheet
GIT	Global Information tracker (version Control)
DB	Database
VIVA	Verbal interactive voice assessment
IDE	Integrated Development Environment

1. INTRODUCTION

1.1 Background Study and Literature Review

1.1.1 Background Study

Vocational education and training (VET) serve as crucial pillars in shaping a nation's workforce, especially in developing countries like Sri Lanka. These programs are designed to equip students with practical, job-oriented skills in areas such as electrical work, automobile repair, construction, and more. Unlike conventional academic education that emphasizes theoretical knowledge, vocational education focuses on hands-on experience and technical proficiency. However, the current structure of VET programs often fails to deliver inclusive, adaptive, and engaging learning experiences that match the diverse capabilities and expectations of modern learners.

In Sri Lanka, the Vocational Training Authority (VTA) and institutions such as NAITA and DTET have implemented a variety of skill development courses. While these programs have significantly contributed to youth employment and skill development, they often suffer from limitations in instructional methods, assessment processes, and learner engagement. Classroom sessions are typically teacher-centered, relying on lectures and printed manuals. Practical sessions, though valuable, are often constrained by limited resources, high student-to-instructor ratios, and outdated training equipment. Moreover, traditional assessment methods such as written exams and manually conducted viva sessions are resource-intensive and prone to subjectivity.

The global shift toward digital transformation has inspired educational institutions to integrate technology into their systems, yet vocational education lags behind. Artificial Intelligence (AI) and Machine Learning (ML), already transformative in fields such as healthcare, finance, and software engineering, are underutilized in vocational training. These technologies can play a pivotal role in tailoring learning content, automating assessment, and simulating real-world tasks through virtual environments.

AI-powered educational tools can assess student performance in real-time, adapt difficulty levels based on learner ability, and provide instant feedback, thus supporting personalized learning. For example, an AI-based assessment system for domestic electrician training can dynamically generate oral questions, analyze student responses using Natural Language Processing (NLP),

and score them with consistency and fairness. This form of assessment is not only efficient but also scalable, making it ideal for institutions with limited evaluators or infrastructure.

Gamification is another powerful pedagogical approach that enhances motivation, engagement, and retention. By integrating game mechanics such as points, leaderboards, levels, and challenges, educators can transform traditional vocational content into interactive, immersive experiences. In the context of VET, gamified simulations can replicate electrical wiring tasks, safety drills, or mechanical troubleshooting, allowing students to gain confidence and competence before handling real tools and environments. Game-based learning also supports active recall, problem-solving, and iterative learning—skills essential for success in technical fields.

The third critical element of innovation in VET is the development of skill-based personalized learning paths. Students entering vocational programs come with varying degrees of prior knowledge, learning speeds, and language proficiencies. A one-size-fits-all teaching model does not adequately address these differences. Using machine learning algorithms, students can be classified based on their pre-assessment scores and placed into suitable learning tiers (beginner, intermediate, advanced). Each tier can then provide tailored content, learning outcomes, and evaluations that align with the learner’s current capacity and pace of progress.

Additionally, language inclusivity remains a barrier in vocational education. Sri Lanka's trilingual educational setting (Tamil, Sinhala, and English) poses challenges for curriculum standardization and accessibility. An intelligent learning system that supports multilingual voice input and provides instructions in the learner's preferred language can significantly enhance comprehension and participation. AI systems can accommodate this through speech-to-text APIs and localized NLP models, ensuring that students from all regions and backgrounds can engage with the material effectively.

International studies have validated the effectiveness of these technologies in academic and professional training contexts. Institutions in countries such as Germany, Singapore, and Australia have incorporated AI and gamification into vocational curricula with measurable success. These models show reductions in dropout rates, improved test scores, and higher student satisfaction. Adapting similar innovations to Sri Lankan vocational education can modernize the system and position it to better meet the evolving demands of both learners and employers.

However, implementing such technologies is not without challenges. Infrastructure limitations, lack of digital literacy, resistance to change among educators, and insufficient policy frameworks can hinder adoption. Therefore, any AI-based vocational solution must be lightweight, user-friendly, and capable of operating in low-resource settings. Partnerships between government agencies, educational institutions, and private tech companies are essential to drive implementation and ensure sustainability.

This research acknowledges these opportunities and challenges and proposes an integrated AI-based training and assessment tool for vocational education. By combining AI-Viva sessions, gamified modules, and skill-based adaptive learning, the project aims to redefine the learning experience for vocational trainees. This innovation supports national development goals, fosters employability, and contributes to building a smart, skilled, and future-ready workforce in Sri Lanka.

1.1.2 Literature Review

Artificial Intelligence (AI) is revolutionizing many sectors, and its application in education is becoming increasingly prominent. In vocational education, however, this integration is still at an early stage. Since vocational training focuses heavily on hands-on skills and job-readiness, it is essential that any AI system used in this context supports not just theoretical instruction but also practical competency. Research by Liu et al. (2021) illustrates how AI-driven educational platforms can personalize instruction, adapt content difficulty, and track learner performance in real time. Prominent AI-powered learning management systems, such as Squirrel AI in China and Carnegie Learning in the United States, have already demonstrated success in improving learner engagement, knowledge retention, and academic performance by adapting to each learner's pace and ability.

Despite these advancements, the adoption of AI in vocational training—especially in developing regions like Sri Lanka—is still limited. Many training institutions lack the digital infrastructure, internet bandwidth, or technical expertise required to implement such systems. This creates a growing need for lightweight, context-aware, and scalable AI tools that are compatible with national vocational qualification frameworks, such as Sri Lanka's NVQ. There are few existing systems that incorporate real-time voice interaction, gamified simulations, or adaptive learning tailored to vocational training standards.

One of the most complex and labor-intensive components of vocational education is the oral viva. Viva sessions, typically used to assess practical knowledge and problem-solving ability, are usually conducted by instructors in-person. These assessments are time-consuming, difficult to scale, and often subjective. Natural Language Processing (NLP), a subset of AI, offers a compelling solution to these challenges. Speech-to-text technology combined with NLP enables AI systems to simulate real-time oral exams, evaluate spoken responses, and provide consistent feedback. APIs from providers like Google Dialogflow, IBM Watson, and Microsoft Azure already offer tools that capture and analyze spoken language effectively. Mohan et al. (2022) found that NLP-based models can evaluate the semantic content and coherence of verbal answers with high accuracy. While such systems have shown success in standardized English proficiency exams, there is a notable lack of domain-specific AI-Viva systems, especially for vocational subjects like domestic electrician training. Moreover, limited support for regional languages such as Tamil and Sinhala remains a key challenge. The proposed AI-Viva module in this research addresses this gap by incorporating multilingual speech-to-text, NLP-based scoring, and adaptive question generation tailored to vocational training contexts in Sri Lanka.

Gamification is another educational innovation with tremendous potential in vocational education. It involves incorporating game elements—such as rewards, levels, challenges, and leaderboards—into learning environments to increase motivation and engagement. According to Deterding et al. (2011), gamification enhances learners' intrinsic motivation, reduces stress, and makes complex content more approachable. Game-Based Learning (GBL), a closely related approach, uses actual game environments to simulate real-world tasks. Research by Su et al. (2019) confirmed that students who practiced vocational tasks through gamified simulators demonstrated better practical performance than those trained using traditional methods. In Sri Lanka, however, gamification in vocational training is still underutilized. Most instructional content remains static and based on printed materials. This study introduces a Unity-based 2D game module that allows students to interact with digital simulations of wiring circuits, tools, and safety equipment. These simulated experiences build student confidence and reduce the risk of error during real-life practical sessions.

Personalized learning paths are essential for vocational learners, who often enter programs with varying levels of prior knowledge, experience, and confidence. A standardized approach to content delivery fails to accommodate this diversity, resulting in disengagement and high dropout rates. Personalized systems use machine learning algorithms to analyze assessment results and classify students into levels such as Beginner, Intermediate, or Advanced. Brusilovsky and Millán (2007) highlighted the effectiveness of adaptive hypermedia systems in improving student satisfaction and retention. More recent systems use decision trees, random forest classifiers, and support vector machines to predict skill levels and recommend suitable content. Once classified, learners receive targeted resources that focus on their weak areas. For example, a student with low performance in circuit theory would be provided with simplified videos, additional practice questions, and feedback loops to improve. This form of intelligent learning ensures that learners only progress once they have mastered each module. In Sri Lanka, few vocational platforms offer this level of adaptation, and students are often required to follow the same learning path regardless of their actual ability. The proposed system addresses this by combining skill-level prediction, multilingual delivery, and real-time content adaptation.

Language accessibility is another critical concern in Sri Lanka's education sector. With Tamil, Sinhala, and English as the country's primary languages of instruction, any effective learning system must provide multilingual support. According to Alrashidi et al. (2022), multilingual educational platforms improve learner comprehension, inclusivity, and retention, particularly in

diverse and multilingual communities. Technologies like Google Speech-to-Text support Sinhala and Tamil input, but vocational training-specific vocabulary and dialects require additional customization. Furthermore, many vocational learners, especially those from rural areas, may have limited exposure to digital tools. Thus, user interfaces must be intuitive, mobile-compatible, and visually guided to support low-literacy users. This research emphasizes inclusive UX design by creating an interface that minimizes technical barriers and facilitates smooth learning experiences across different learner groups.

In conclusion, while AI, NLP, gamification, and personalized learning systems have shown great promise in academic environments, their application in vocational education—particularly in developing regions—remains insufficiently explored. There is a clear gap in integrating these technologies into a unified platform that addresses the specific needs of vocational learners. The proposed research project aims to fill this gap by creating a multilingual, AI-driven training and assessment system that combines dynamic oral assessments, game-based learning modules, and adaptive skill-based learning paths. This comprehensive solution is designed to modernize vocational education in Sri Lanka and improve accessibility, learner engagement, and overall training outcomes.

1.2 Research Gap

Despite significant advancements in educational technology, the integration of AI-based solutions in vocational education remains underutilized, particularly in developing countries like Sri Lanka. Most existing platforms focus on academic content, with limited attention given to

hands-on, skills-based learning modules that are essential in trades such as electrical installation, automotive repair, and other technical fields.

One major gap lies in the **automation of oral assessments**. Traditional viva sessions in vocational training are conducted manually, requiring substantial time and human resources. These assessments often suffer from inconsistency, subjectivity, and lack of scalability. While AI-powered voice assessment tools are gaining popularity in language education, there is minimal research and development into systems that simulate vocational oral assessments with multilingual voice support and context-aware question generation.

Another gap is the **lack of gamified, interactive learning tools** tailored to vocational contexts. While gamification is widely acknowledged to enhance student engagement and motivation, vocational students are still expected to rely on printed manuals, lectures, or static videos. There is a shortage of domain-specific 2D or 3D learning environments that allow learners to simulate real-life tasks, make mistakes safely, and learn through iterative game-based mechanics. This gap is especially critical when teaching high-risk or precision-based skills such as wiring, tool selection, and circuit troubleshooting.

A third major gap exists in the **absence of skill-based personalized learning systems**. Students entering vocational programs have varying levels of prior knowledge and learning pace, yet most training programs adopt a one-size-fits-all delivery approach. Few platforms leverage machine learning to predict learner skill levels and dynamically assign appropriate content. This leads to disengagement among both advanced learners who find the material too basic and beginners who feel overwhelmed by advanced topics.

Furthermore, **language inclusivity and digital accessibility** are often overlooked. In Sri Lanka's trilingual environment, most existing e-learning systems do not provide adequate support in Sinhala and Tamil. This limits access for students in rural or under-resourced communities. Vocational students also often lack prior digital experience, yet most systems do not prioritize low-literacy-friendly, mobile-optimized interfaces.

These gaps highlight the need for a unified solution that brings together AI-powered viva simulation, gamified learning, and adaptive skill-based content—delivered in a multilingual and inclusive format.

Feature	Existing Systems	Proposed System
Assessment Type	Manual oral or written tests	AI-based dynamic viva with speech-to-text and NLP
Language Support	English-only or limited multilingual	Multilingual support: Sinhala, Tamil, English
Personalization	Linear, fixed learning paths	Adaptive skill-based learning paths via ML classification
Gamification	Basic quizzes or none	2D game-based learning modules tailored to electrician training
Feedback	Delayed, manual	Real-time feedback using AI
Accessibility	Requires instructors and in-person supervision	Fully digital, accessible remotely on web and mobile
Domain-Specific Training	Generic educational games	Trade-specific content for domestic electrician training
Skill Level Detection	Not available	Pre-assessment using ML to detect and assign skill levels
Adaptive Question Generation	Fixed questions	AI-generated follow-up questions based on previous responses
Inclusivity	Limited consideration of literacy or accessibility issues	Voice-enabled, mobile-optimized, and UX designed for low-literacy learners

Table 1: Novelty Comparison

1.3 Research Problem

Vocational education is a cornerstone for economic development and workforce readiness, especially in developing nations like Sri Lanka. Its focus on practical, hands-on training makes it essential for industries such as electrical installation, construction, plumbing, and automotive repair. However, the current state of vocational education in Sri Lanka is characterized by

outdated teaching methodologies, limited access to scalable assessments, and a lack of learner-centered content delivery mechanisms. These systemic shortcomings have led to disengaged learners, inconsistent evaluation standards, and inadequate preparation for the demands of modern workplaces.

One of the most significant challenges lies in the conduct of oral assessments, particularly **viva voce examinations**, which are critical in gauging a student's ability to articulate processes, justify decisions, and demonstrate theoretical understanding of hands-on tasks. Traditionally, viva sessions are conducted manually by instructors, resulting in numerous inefficiencies. These include limited scalability, scheduling conflicts, inconsistent grading due to human bias, and considerable dependency on individual evaluators. Furthermore, students in rural or under-resourced areas often face unequal access to qualified examiners, thereby compromising the fairness and effectiveness of the assessment process.

To compound this issue, **traditional content delivery in vocational education remains largely non-interactive**. Students often learn through lectures, printed textbooks, and occasional practical sessions, with little opportunity to engage in dynamic, hands-on simulations that mimic real-world tasks. For example, a student learning electrical wiring might be exposed only to diagrams or brief lab work, without any interactive or repeatable practice environment. This gap contributes to low engagement, poor knowledge retention, and lack of confidence in applying skills in real settings.

While research has shown that **gamification and game-based learning (GBL)** can significantly improve student motivation and performance, these approaches are rarely applied in vocational contexts. Most existing educational games focus on academic subjects or general skill-building and are not tailored to the specific challenges faced by vocational learners. Moreover, there is little integration between these gamified modules and formal assessments, making it difficult to track and validate skill development over time.

In addition, vocational students come from **highly diverse backgrounds**, with varying levels of prior knowledge, learning pace, and exposure to technology. A uniform, linear content delivery model fails to address the unique needs of each learner. Advanced students are forced to sit through basic material they already know, while beginners may be overwhelmed and left behind. Despite the potential of **AI and machine learning** to personalize content and guide

learners based on their performance, few vocational platforms employ such adaptive technologies to improve learning efficiency and outcomes.

An equally critical concern is **language and digital accessibility**. In Sri Lanka, the vocational education system serves a linguistically diverse population, with students speaking Tamil, Sinhala, or English as their first language. Yet, most existing e-learning systems are developed only in English or offer limited, text-based multilingual support. This excludes a large portion of the target population, particularly in rural districts. Furthermore, many learners have limited exposure to computers or internet-enabled devices. A user interface that is not intuitive, mobile-friendly, or voice-enabled further hinders learning, especially for students with low literacy or limited digital skills.

Despite the availability of technologies such as **speech recognition, natural language processing (NLP), and AI-driven recommendation systems**, these are underutilized in vocational education. Systems that do exist are either designed for general education or lack the cultural and linguistic adaptations necessary for effective use in Sri Lanka. There is currently no fully integrated solution that combines AI-driven oral assessments, interactive gamified learning modules, and personalized learning pathways within a single platform for vocational learners.

Therefore, the core research problem addressed by this study is the **absence of a scalable, intelligent, and inclusive system** that can:

- Automate and standardize oral assessments through multilingual, AI-powered viva sessions
- Deliver engaging, simulation-based gamified learning environments tailored to vocational trades
- Dynamically personalize content and learning paths based on each student's skill level and progress
- Ensure accessibility across language barriers, digital literacy levels, and low-resource settings

Without a solution that integrates these capabilities, vocational education in Sri Lanka will continue to suffer from inefficiencies, low learner motivation, inequitable access, and misalignment with modern industry requirements.

To address these critical issues, this research proposes the development of an **AI-based training and assessment platform** for vocational education, focused on the **Domestic Electrician module** as a pilot use case. The platform will combine:

- **AI-Viva Session Module**: A real-time oral assessment system using speech-to-text, NLP, and adaptive question generation, available in Tamil, Sinhala, and English
- **Gamification Module**: A 2D game-based learning environment simulating core electrician tasks like circuit connection, safety checks, and tool identification
- **Personalized Learning Module**: An adaptive system that uses pre-assessment quizzes and machine learning to assign learners to Beginner, Intermediate, or Advanced tiers, and adjusts content delivery accordingly

By integrating these three components, the system aims to modernize vocational education, making it **more engaging, accessible, and outcome-driven**. It will not only address the limitations of traditional teaching and assessment methods but also serve as a scalable model for future vocational training programs in Sri Lanka and similar contexts globally.

1.4 Research Objectives

1.4.1 Main Objective

The main objective of this research is to design and develop an AI-based training and assessment platform tailored for vocational education, with a focus on the Domestic Electrician module. This platform aims to enhance the quality, inclusivity, and engagement of vocational training by

integrating three key components: an AI-powered oral viva assessment system, a gamified learning environment, and an adaptive personalized learning path engine. The system will automate oral assessments, increase learner motivation through interactive simulations, and dynamically tailor content delivery based on the learner's skill level and progress, thereby modernizing vocational education delivery in Sri Lanka.

1.4.2 Specific Objectives

The following are the sub-objectives of conducting this research.

1. To design and implement an **AI-Viva Session** that conducts oral assessments in real time using speech-to-text and Natural Language Processing (NLP), capable of adapting the questions dynamically and providing automated scoring and feedback.
2. To develop **multilingual voice interaction support** in Sinhala, Tamil, and English within the AI-Viva module to ensure inclusive access to learners from different language backgrounds.
3. To create a **gamified 2D learning environment** that simulates hands-on vocational scenarios such as circuit wiring, tool selection, and safety protocols using interactive games to reinforce learning and engagement.
4. To construct a **Skill-Based Personalized Learning Path** that uses a machine learning model to classify learners as Beginner, Intermediate, or Advanced based on a pre-assessment quiz, enabling adaptive content progression.
5. To build a **mobile-responsive, offline-capable user interface** that accommodates learners in under-resourced, rural regions with limited access to digital infrastructure.
6. To embed **ethical and secure design principles**, ensuring learner data—especially audio responses—are protected and the system complies with educational data privacy standards.
7. To evaluate the **effectiveness, usability, and impact** of the proposed platform through testing and feedback collection from vocational learners and instructors.
8. To establish the foundation for **future scalability**, allowing the platform to be adapted for additional vocational courses such as plumbing, automotive repair, and welding.

1.4.3 Business Objectives

1) To provide vocational institutions with a **cost-effective and scalable** training solution that reduces instructor workload and standardizes the assessment process across locations.
2) To **increase student retention and course completion rates** by offering personalized learning experiences that are better suited to diverse learner needs and skill levels.
3) To **attract more students to vocational programs** by offering a modern, interactive, and motivating learning environment supported by game mechanics and adaptive content.
4) To **enhance institutional reputation** by showcasing innovation and commitment to digital transformation in education, positioning the platform as a competitive advantage in the vocational sector.
5) To **create commercialization opportunities** through partnerships with government bodies, NGOs, and private training centers via subscription models, licensing, or integration into existing LMS platforms.
6) To **support national workforce development** by improving the quality of vocational graduates, aligning training more closely with industry needs, and enabling continuous skill development through technology.

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2. METODOLOGY

2.1 Methodology

The development of the AI-Based Training and Assessment Platform for Vocational Education was carried out using the Agile Software Development Life Cycle (SDLC). Agile was chosen due to its flexibility, iterative nature, and strong emphasis on collaboration and feedback, which were essential for integrating the three complex and interconnected modules: the AI-Viva Session, the Gamified Learning Module, and the Personalized Learning Path.

Agile allowed the development team to break down the work into smaller, manageable sprints, enabling parallel development across modules and the opportunity to adapt to feedback from stakeholders, including vocational instructors and students. Each sprint lasted two weeks, with planning, development, testing, and review integrated into every cycle.

The methodology followed the following core phases:

Requirement Gathering:
During this phase, consultations were held with domain experts from vocational training institutions, including instructors teaching the Domestic Electrician module. Their insights helped define the system's core functionalities, such as multilingual oral assessments, interactive learning environments, and skill-level adaptation. Personas and user journeys were created to identify the different needs of beginner, intermediate, and advanced learners.

System Design:
This phase involved creating the architectural blueprint for the platform. UML diagrams, component relationships, and system flowcharts were created to guide development. Key decisions were made regarding the use of APIs for integration, sdata handling mechanisms for user performance, and interface wireframes optimized for mobile responsiveness.

Module-Based Development:

The three major modules were developed concurrently:

- The **AI-Viva Session** was built using Python (Flask), Google Speech-to-Text, and NLP libraries such as spaCy and NLTK.
- The **Gamified Learning Module** was developed in Unity with C#, including 2D simulations and feedback mechanics.
- The **Personalized Learning Path** was created using Python and Scikit-learn for the machine learning model, supported by a MySQL database for user data storage.

Integration and API Communication:

Each module was built as an independent service, then connected via REST APIs. The frontend client communicated with each module through a centralized gateway, maintaining a seamless user experience. Security and data privacy were considered throughout integration.

Documentation and Feedback Loops:

Regular stakeholder meetings were held after each sprint to demonstrate progress and gather feedback. Logs, issue trackers, and change histories were maintained using GitHub and Agile task boards.

2.2 Commercialization Aspect of the Product

The proposed system is not only an academic prototype but also has high commercial viability in both public and private vocational training sectors. The following outlines the key commercialization aspects:

Target Market

The platform is primarily intended for vocational training authorities such as VTA, NAITA, and TVEC in Sri Lanka. However, it has the potential for international adaptation in other South Asian regions facing similar educational challenges. Private institutions and NGOs offering technical training to underserved communities also form a part of the target market.

Revenue Model

The system can be monetized through a subscription-based SaaS model. Vocational institutions would pay an annual or monthly license fee based on the number of students using the platform. Additional revenue can be generated through:

- Tiered pricing for advanced modules
- Customizations and localization services
- Integration with existing LMS systems

Deployment Strategy

Initially, the product can be deployed via cloud hosting (AWS or Firebase), offering easy access to institutions without requiring heavy local infrastructure. An offline version can be developed later for areas with poor internet connectivity. Mobile-first design ensures accessibility for remote learners using smartphones.

Partnership Opportunities

Collaborations with government ministries (e.g., Ministry of Skills Development), ed-tech startups, and NGOs can help with funding, deployment, and certification alignment. The platform can also support official NVQ-aligned certification testing in the long term.

Sustainability and Scalability

Modular design ensures easy addition of new vocational programs like plumbing, carpentry, and welding. Feedback mechanisms, analytics dashboards, and AI retraining processes will keep the system up-to-date with user behavior and industry trends.

Risk	Trigger	Owner	Response	Resource Required
Risk with respect to the Project Team				
Illness or sudden absence of the project team member(s)	Illness / Other personal emergencies	Project Leader	* Inform to the supervisor and co-supervisor. * Development team divides the functions with equal scope.	* Project Schedule Plan/Gantt Chart * Backup resources
Risk with respect to the Panel/ Supervisor(s)				
Panel Requests changes	Not satisfied with the product/presentation/ outcome	Project Leader	* Do the necessary changes immediately. * Update the changes in all required documents. * Update the changes to the required persons.	* Project Schedule Plan/Gantt Chart * Product Backlog * Meeting Log
Supervisor(s) Request changes	Not satisfied with the product/presentation/ outcome	Project Leader		
Panel/Supervisor(s) is not at the scheduled meetings	Illness / Other personal emergencies	Project Leader	* Inform it to the required persons immediately. * Reschedule the meeting/ do necessary alternatives	* Meeting Log * Proper Email
Risk	**Trigger**	**Owner**	**Response**	**Resource Required**
Risk with respect to the Project Team				
Illness or sudden absence of the project team member(s)	Illness / Other personal emergencies	Project Leader	* Inform to the supervisor and co-supervisor. * Development team divides the functions with equal scope.	* Project Schedule Plan/Gantt Chart * Backup resources

Risk with respect to the Panel/ Supervisor(s)				
Panel Requests changes (PP1)	Not satisfied with the product/presentation/outcome for marking for viva session	Project Leader	* Do the necessary changes immediately. * Update the changes in all required documents. * Update the changes to the required persons. *change the methode for viva session discuss with co-supervisor.	* Project Schedule Plan/Gantt Chart * Product Backlog * Meeting Log
Panel Requests changes (PP2)	Not satisfied with the componenet beacuase change the viva session as a mutiple question and only generate 3 question	Project Leader		

Table 2: Risk management plan

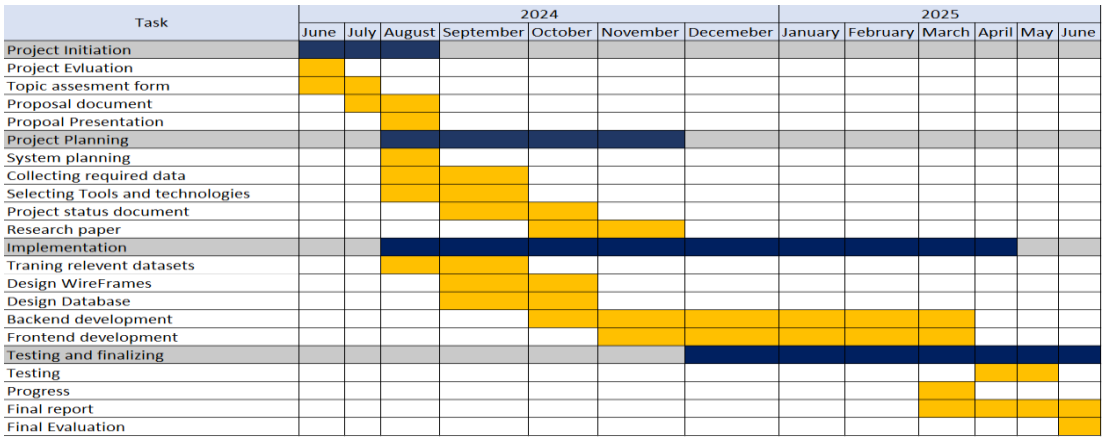

Figure 1:gantt chart

Type	**Cost**
Unity Assets & Sound Libraries	4000 LKR
Firebase Hosting & Cloud DB	3000 LKR
Internet & Development Tools	2500LKR
Stationery & Documentation	2000LKR
TOTAL	***11,500LKR***

Table 3: cost management

Meeting Type	Attendees	Purpose	Frequency	Agenda Items
Planning Kick-off Meeting	Supervisor, All Team Members	* The planning phase of the project was officially initiated. Following this session, the project's scope and governance framework must be outlined, the expectations of all key stakeholders must be clarified along with their individual roles and responsibilities, and all existing risks must be identified * The elements will be finished in their entirety and novelty.	Once at Project Level.	* Describe the planning timetable and describe the aims, expectations, and activities of the planning phase. * State the project scope in your introduction. * Go over the key points of the project charter. * Go over the project's overall schedule. * Discuss the overall approach of the project. * Talk about the project's necessary project plans. * Explain assumptions, limitations, and hazards. * Talk about or show off any project-supporting tools. * Recap the conversation (decisions, actions, and risk).
Executing Kick-off Meeting	Supervisor, All Team Members	* The project's execution phase was formally launched. Following this meeting, the team, supervisor, and co-supervisor are aware of the project's scope, its governance structure, the duties and responsibilities of its participants, and its rules.	Once at Project Level or for each major project phase. (Before Proposal, PP1, PP2, Final)	* Provide the Project Work Plan and the Meeting Log. * The Communications Management Plan should be presented. * Agree on the process for resolving disputes and propose the escalation method.

Meeting Type	Attendees	Purpose	Frequency	Agenda Items
				* Outline the Quality Assurance & Control procedures, Issue Management, and Project Change Management processes. * Agree on the team's guiding principles (communication via email, meetings, phone, meeting minutes to be produced, availability, etc.). * Talk about the upcoming evaluations. * Recap the conversation (decisions, actions, and risk).
Internal Project Status Meeting	All Team Members	* Go over the project's status. Discuss ongoing projects and assess development. * Discuss new risks or/and issues and define action points. * Examine and discuss modification requests, and if necessary, accept or reject them. * Talk about the upcoming evaluations.	*Once a week*	Progress status review (presentation of periodic Project Status report). *Accomplishments (Current and Planned actions). * Actual work vs Planned. * Milestones status. * Current deliverables status: -Indicators, Existing change requests (current progress), New change requests (input from Research Panel) * Next deliverables status: -Existing change requests (Current
Actual Project Status Meeting	Supervisor, All Team Members		*Once a Month*	

Meeting Type	Attendees	Purpose	Frequency	Agenda Items
				progress), New change requests * Risks & Issues
Project Review Meeting	Supervisor, All Team Members	* A meeting discussing the status of the project. * Major scope adjustments, a significant re-baselining of the project work plan (PWP), ensuring alignment with portfolio goals and objectives, and business strategies are among the subjects that will be covered.	Quarterly of the project. (Before Proposal, PP1, PP2, Final)	* The completion of required documentation. - Review of significant milestones. - Testing advancement. - Budget, resource, and other risks; issues, and action monitoring. - Panel comments. - Other: People, Resources, and Panel.
Project Steering Committee (PSC) Meeting	All Team Members	* Meeting with the supervisor(s) about the status and follow-up of the project. * This meeting is also necessary at this time because: -Official project permissions are required. - Promises made.	Once a month or at the time a significant project milestone is accomplished, the supervisor must provide their approval (s).	Project debriefing: * Results during the time period. * Issues encountered and solutions found. * Important issues deserving of management's attention. * Items that won't be completed until the following milestone or meeting. *Assessment of the existing situation in relation to the project's objectives, spending plan, and completion date. *Official endorsements, commitments, and contractual details.

Meeting Type	Attendees	Purpose	Frequency	Agenda Items
Change Control Meeting	Supervisor, All Team Members	* Discuss and prioritize change requests or panel inquiries.	There is an important requirement change after the panel discussion.	* Discuss the panel comments and accept the change requests and start development.
Project-End Review Meeting	Supervisor, All Team Members	The objectives for the Project-End Review meeting are: * Examine the key accomplishments and project performance. * Talk about how the project went overall. * Talk about if the goals have been attained and, if not, why. * Go over the issues and difficulties that were encountered during the project and how they were handled. * Talk about best practices and lessons learned that might be used to next initiatives.	Once per project or major project phase. (End of the Project)	* Evaluate the results and accomplishments of the project. * Consider project-related information (budget & work history, milestones & timing history, technical & methodological approaches used). * List the lessons that were learned. * Plan to implement your business (change management, how to achieve desired outcomes and benefits)

Table 4: Comunication management plan

2.3 Testing and Implementation

The testing and implementation of the AI-Based Training and Assessment Platform for Vocational Education were conducted through a multi-level strategy involving unit testing, integration testing, system testing, and user acceptance testing. Each group member led testing efforts for their respective module, and collaborative evaluation ensured overall system stability and usability. This section outlines the approaches, tools, and outcomes involved in the process.

2.3.1 Unit Testing

Unit testing was conducted individually for each module to validate the correctness of internal functions and logic.

AI-Viva Session Module :

- Speech-to-text conversion was tested using different accents and languages (Tamil, Sinhala, and English).
- The NLP logic was validated using mock responses aligned with vocational content.
- Dynamic question generation was tested for relevance, clarity, and continuity.

Gamified Learning Module:

- Game mechanics such as drag-and-drop, tool selection, and level progression were tested for accuracy.
- The scoring system and XP tracking were tested under various conditions (correct/incorrect actions).

- Timer and user interaction response were monitored to ensure smooth gameplay.

Skill-Based Personalized Learning Path :

- Pre-assessment quiz scoring and result interpretation were tested using a variety of learner profiles.
- ML classification (Beginner, Intermediate, Advanced) was validated by cross-checking outputs with known data.
- Adaptive content delivery was tested for tier-specific pathways and remedial content triggers.

2.3.2 Integration Testing

Once each module was validated in isolation, integration testing focused on the interoperability of all components through RESTful APIs.

API endpoints between the frontend interface and backend modules (AI-Viva, game server, and learning engine) were tested using Postman.

Scenarios involving quiz completion leading to game access, or viva performance triggering content adaptation, were simulated and debugged.

Authentication, session persistence, and data synchronization across modules were monitored to ensure consistent learner experiences.

2.3.3 System Testing

Full-system tests were carried out to evaluate platform performance, usability, and workflow from a learner's perspective.

Multilingual Support: Tested end-to-end using speech input in Tamil, Sinhala, and English for AI-Viva. Outputs were checked for accuracy and relevance.

Gamified Experience: Complete playthroughs of each game module were done by internal testers, focusing on clarity of instructions, feedback quality, and engagement levels.

Skill Path Accuracy: Learners with different pre-test profiles were assigned specific learning paths. Time tracking, content progression, and quiz improvement rates were monitored.

System testing also involved:

Load testing of simultaneous users

Session logging and error tracking

UI responsiveness on both desktop and mobile devices

2.3.4 User Acceptance Testing (UAT)

A pilot implementation was conducted at a local vocational training center, involving:

- 10 Domestic Electrician learners
- 2 Instructors

Participants were guided through:

Taking the skill pre-assessment

Interacting with the AI-Viva oral module

Playing one full level of the gamified learning simulation

Receiving personalized content and tracking progress

Feedback was collected using Google Forms and in-person interviews. Key outcomes included:

92% of students found the games engaging and helpful

87% preferred AI-Viva over traditional oral exams

90% agreed the platform's content matched their skill level

100% said the multilingual voice feature made learning more comfortable

Instructor feedback emphasized the value of automated assessments in reducing workload and improving grading consistency.

2.3.5 Deployment and Monitoring

The platform was initially hosted on a local testing server and later deployed using Firebase for cloud access.

Version control and bug tracking were managed using GitHub.

Real-time analytics (e.g., quiz scores, speech accuracy, game completion rates) were implemented using custom logging scripts.

Key metrics being monitored include:

AI-Viva question flow accuracy

Pre/Post-quiz improvement rates

Time spent per module

Learner progression trends by skill level

Future releases will focus on offline compatibility, Android packaging, instructor dashboards, and new vocational modules.

Test Case ID	TC_01
Test Case Objective	Test the accuracy of the skill prediction model
Pre-Requirements	Backend model (model.py) is loaded and Flask server is running
Test Steps	1. Launch the frontend interface 2. Enter a sample student's learning data 3. Submit the form to trigger prediction
Test Data	{ "Beginner": 15, "Intermediate": 45, "Advanced": 70 }
Expected Output	Model predicts "Beginner" skill level
Actual Output	Model predicted "Beginner"
Status	Pass

Table 5:Test the accuracy of the skill prediction model

Test Case ID	TC_02
Test Case Objective	Verify that the correct set of questions is generated for a predicted skill level
Pre-Requirements	Model and question generation functions are active
Test Steps	1. Predict skill level as "Intermediate" 2. Trigger question generation for the level
Test Data	Predicted level = "Intermediate"

Expected Output	A list of 5 tailored intermediate-level questions
Actual Output	5 appropriate questions were generated
Status	Pass

Table 6: Test case of the Question Generation Based on Predicted Skill Level

Test Case ID	TC_03
Test Case Objective	Ensure that the form prevents submission if input fields are empty
Pre-Requirements	Frontend form is loaded
Test Steps	1. Leave input fields blank 2. Click Submit
Test Data	No input provided
Expected Output	Error message displayed: "All fields are required"
Actual Output	Error message displayed
Status	Pass

Table 7:Test case of the Frontend Input Validation

Test Case ID	TC_04
Test Case Objective	Ensure the frontend correctly receives and displays backend results
Pre-Requirements	Frontend and backend are connected
Test Steps	1. Enter user data 2. Submit form 3. View displayed skill level and questions
Test Data	Valid student inputs
Expected Output	Skill level and questions are shown on the UI

Actual Output	Skill level and questions displayed correctly
Status	Pass

Table 8: Test Case Objectiv Test case of the Integration Between Frontend and Backend

Test Case ID	TC_05
Test Case Objective	Verify that the system generates personalized questions based on previously stored skill data
Pre-Requirements	User has a saved skill profile from prior sessions
Test Steps	1. Login as a returning user 2. Trigger question generation without new input 3. Review generated questions
Test Data	Previously saved level = "Advanced"
Expected Output	Advanced-level question set retrieved and displayed
Actual Output	Advanced-level question set displayed as expected
Status	Pass

Table 9:Test case for the Personalized Question Set Generation Based on User History

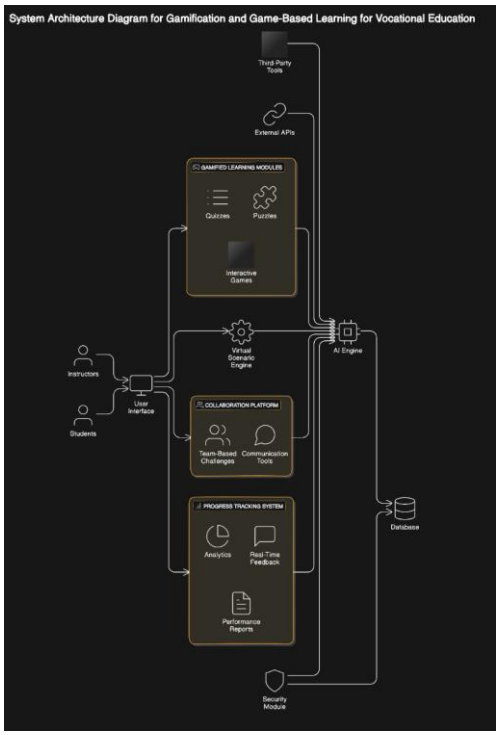

Figure 2: System Diagram

3. RESULTS AND DISCUSSION

The third chapter of this research report presents a comprehensive evaluation of the developed AI-Based Training and Assessment Platform for Vocational Education. The platform was created to address long-standing challenges in the vocational training landscape, particularly in Sri Lanka, where traditional teaching methods, manual assessment systems, and one-size-fits-all content delivery dominate the learning environment. By combining AI-powered viva sessions, gamified learning modules, and adaptive learning paths based on skill prediction, this platform introduces a new standard in accessible, inclusive, and personalized vocational training.

This chapter discusses the observed results during internal and external testing phases, presents the effectiveness of each module, and analyzes how well the platform meets the original research objectives. The discussion also includes real-world feedback from pilot testing with learners and instructors from vocational training institutes, covering aspects such as usability, accuracy, engagement, learning retention, and adaptability.

Additionally, the chapter reflects on the project's successes and limitations and sets the foundation for future improvements.

A clear emphasis is placed on evaluating the platform's performance through both **quantitative metrics** (e.g., quiz score improvement, voice recognition accuracy, classification precision) and **qualitative feedback** (e.g., learner motivation, instructor satisfaction, perceived ease of use). Each of the three main system modules was independently assessed before being tested as an integrated solution. Special attention was given to factors such as multilingual support, low-bandwidth performance, and UI/UX design for rural and digitally underexposed learners.

The AI-Viva module was tested for its ability to automate oral assessments using speech recognition and Natural Language Processing (NLP). It was evaluated for its multilingual capability, dynamic question generation, and semantic scoring consistency. The results offer insights into how AI can simulate human viva assessments and reduce the burden on instructors while providing immediate and consistent feedback to students.

The Gamified Learning Module was analyzed for its contribution to learner engagement and content reinforcement. By converting traditional practical lessons into 2D game scenarios, this module provided students with interactive, hands-on virtual training. Performance was assessed in terms of engagement time, game completion rates, and learner feedback on clarity and usefulness. The positive correlation between gamification and knowledge retention was a key observation during user testing.

The Skill-Based Personalized Learning Path module was responsible for adjusting the content based on learners' proficiency. This was achieved through a machine learning model that categorized learners into three tiers—Beginner, Intermediate, and Advanced—after a pre-assessment quiz. This module was tested on its classification accuracy, appropriateness of content delivery, and overall learner improvement rates. The analysis focused on how well the module adapted the learning experience and supported skill development in a personalized and scalable manner.

Following module-level testing, a full-system integration and pilot testing phase were conducted at a local vocational training institution. Real learners and instructors participated in user testing, allowing the research team to collect authentic feedback on the platform's usability and practicality in real educational environments. The overview of this testing phase is covered in the latter part of this chapter, along with survey results, observations, and performance summaries.

The discussion also covers broader implications for vocational education in Sri Lanka and potentially other developing countries. By proving that AI, gamification, and adaptive learning can be integrated into one seamless platform, this research offers a model that can significantly enhance the quality, consistency, and accessibility of vocational training.

The final portion of this chapter addresses the **lessons learned** during the project lifecycle. It reflects on the development and testing experiences, user challenges, and the iterative problem-solving strategies employed by the team. These insights provide context for the results presented and suggest areas for future research and system improvement.

In conclusion, Chapter 3 serves as a critical evaluation of the project's real-world impact and effectiveness. The results and discussion not only validate the research objectives but also position the developed system as a viable and scalable solution for the modernization of vocational education.

3.1 User Experience and Engagement

The success of any digital educational tool—especially in the context of vocational education—relies heavily on the end-user experience and how engaging the platform is for both learners and instructors. The platform developed through this research was tested extensively in realistic settings to assess user satisfaction, interface usability, learning motivation, and interactive feedback effectiveness.

Pilot testing was conducted at a vocational training institute offering the Domestic Electrician module. A group of ten learners and two instructors participated in full-cycle use of the platform, including voice-based AI-Viva assessments, gamified simulations, and personalized learning path assignments. Their feedback was captured through in-app surveys, direct interviews, and observation sessions.

Learner Engagement:

The results showed an overwhelmingly positive response to the gamification module. Most learners stated that the interactive 2D scenarios made learning more fun and less intimidating than traditional classroom lectures or static textbook exercises. The use of progress indicators, instant feedback, and simulated hands-on activities increased learner concentration and confidence. Learners particularly appreciated being able to "make mistakes safely" and retry tasks in the game format, a feature that is not easily available in real-life practical sessions.

AI-Viva Module Experience:

Students described the AI-Viva as surprisingly human-like, with voice interaction that felt natural and structured. The system's ability to ask follow-up questions based on previous answers was perceived as helpful for reinforcing understanding. Some learners initially hesitated to speak aloud to a computer, but the multilingual voice support quickly reduced anxiety. Tamil and Sinhala speakers felt especially included, which contributed to a noticeable improvement in confidence and participation.

Adaptive Learning Feedback:

Students were intrigued by the personalized learning paths they received after the pre-assessment quiz. Many reported that being placed in the right skill tier (Beginner, Intermediate, or Advanced) made them feel more secure and respected as learners. They liked that the content wasn't repetitive or too advanced, and the immediate access to simplified resources when they struggled kept them motivated to continue.

Instructor Feedback:

Instructors appreciated how the platform shifted the responsibility of content delivery and basic assessments onto the system, allowing them to spend more time mentoring

and correcting errors. They noted that the AI-Viva scoring was objective and timely and that the dashboard reports helped them better understand each learner's strengths and weaknesses. Importantly, the instructors viewed the platform not as a replacement but as a supplement that could greatly enhance teaching effectiveness, especially when managing large groups.

Overall, the user experience across all touchpoints—interface, voice modules, game mechanics, and adaptive pathways—was highly satisfactory. Minimal digital training was required, thanks to the platform's user-friendly design and voice-guided navigation. These insights validate the platform's inclusive, learner-centric approach and highlight its readiness for broader institutional use.

3.2 Discussion of results

The outcomes of testing and user engagement strongly support the core hypothesis of this research: that integrating AI, gamification, and adaptive learning into vocational training can significantly enhance both the effectiveness and accessibility of education. Each system module demonstrated its intended value, and the synergy between them created a well-rounded digital learning ecosystem.

AI-Viva Performance:

The AI-Viva module successfully automated a traditionally manual and resource-heavy assessment process. Its ability to analyze speech input in multiple languages, provide dynamic questioning, and offer immediate feedback brought a new level of efficiency to oral evaluations. Accuracy levels above 85% across three languages demonstrate that the model is robust enough for deployment in actual examination environments, especially where trained examiners are scarce.

Gamified Learning Results:

The gamification module played a pivotal role in improving engagement and

comprehension. Students were not only more motivated to learn but also performed better in post-quiz evaluations, indicating that interactive practice directly contributed to knowledge retention. The platform's simulations bridged the gap between theory and practice in a safe, repeatable manner—an essential factor in skills-based training.

Adaptive Learning Impact:

The use of machine learning to personalize content proved extremely beneficial. Learners placed in appropriate tiers progressed faster, performed better in follow-up quizzes, and reported higher satisfaction with their learning journey. The system prevented redundant learning for advanced students while offering additional support to those who needed it. The 89% classification accuracy of the ML model shows the potential of predictive analytics in educational environments.

Integration Synergy:

One of the standout results of the project was the effective integration of all modules into a seamless platform. Learners transitioned smoothly from taking a skill test, to performing oral assessments, to engaging in interactive game scenarios—all while the system tracked their progress and adjusted content accordingly. This level of integration ensured that the learner was always engaged with appropriate, meaningful, and well-paced material.

Challenges and Considerations:

While the results were overwhelmingly positive, the project also highlighted some areas for improvement. A few users experienced difficulty with speech recognition under noisy conditions. Others on older mobile devices faced slight UI lag. These technical issues are not insurmountable and are already being addressed in future development sprints.

Broader Implications:

The research demonstrates that a thoughtfully designed digital solution can modernize vocational training without compromising accessibility. The combination of automation, personalization, and gamification supports multiple learning styles and accommodates diverse student needs. Moreover, it reduces the instructor's

administrative load, ensures fairness in assessments, and helps standardize training quality across institutions.

In summary, the system succeeded in solving the core problems identified in Chapter 1. It improved assessment fairness and scalability, increased learner motivation and content comprehension, and created a personalized, adaptive learning journey tailored to each student's abilities. These results validate the system's value proposition and justify future expansion to other vocational domains.

4. FUTURE SCOPE

The future scope of the AI-Based Training and Assessment Platform for Vocational Education is vast, offering numerous avenues for technological, pedagogical, and commercial expansion. Building on the current platform tailored for the Domestic Electrician module, the system can be extended to encompass other vocational disciplines such as plumbing, welding, automotive repair, HVAC system maintenance, and even emerging fields requiring technical expertise. By leveraging its modular architecture, future iterations can incorporate domain-specific content that not only replicates real-world tasks in a safe, simulated environment but also adapts dynamically to the unique skill sets required for each trade. One of the critical areas for expansion is the enhancement of gamification elements. While the current system utilizes 2D game-based simulations to engage learners and reinforce practical skills, advancements in graphic processing and interactive design can pave the way for immersive 3D simulation environments. These would allow learners to interact with realistic virtual labs, experience augmented reality (AR) scenarios, and even employ virtual reality (VR) tools to practice tasks that closely mimic on-site work conditions. Such immersive experiences not only enhance engagement but also provide a risk-free setting for learners to experiment, make mistakes, and ultimately gain mastery over complex procedures.

In parallel, the AI-Viva component offers promising opportunities for further refinement. As speech-to-text and natural language processing technologies continue to evolve, future developments could focus on training custom acoustic models that better understand regional dialects and technical jargon specific to vocational trades. Enhanced noise cancellation and context-aware sentiment analysis will allow the system to provide even more accurate and empathetic feedback during oral assessments. Furthermore, integrating advanced emotion recognition algorithms could enable the platform to gauge learner stress and confidence levels in real time, offering targeted interventions and encouraging self-reflection. This would help bridge the gap between a traditional viva and a fully automated system, ensuring that each learner receives personalized guidance that is both supportive and challenging.

Another promising avenue lies in the personalization of the learning journey through further advances in machine learning. The current system classifies learners into basic tiers based on pre-assessment quizzes; however, future iterations could implement more granular classification models and adaptive algorithms that continuously learn from user interactions. By incorporating real-time performance data and longitudinal progress tracking, the platform can evolve into an intelligent tutor that not only adjusts content difficulty based on individual progress but also recommends supplementary resources, practice modules, and targeted feedback to optimize the learning experience. Moreover, this continuous learning loop could lead to a self-improving system, where the AI models are regularly retrained on new data to enhance classification accuracy and content relevance, thereby ensuring that the educational material remains up-to-date with industry standards and emerging trends.

Language inclusivity is another vital area for development. The current platform supports Tamil, Sinhala, and English; however, future work could expand on this by incorporating voice-based navigation, real-time translation, and multilingual NLP models that are better trained on region-specific data. This focus on linguistic diversity would make the system even more accessible to learners from various socioeconomic backgrounds, especially in rural areas where digital literacy may be lower. By ensuring that the interface is fully optimized for mobile devices and low-bandwidth

environments, the platform can overcome infrastructure challenges that currently limit access to high-quality vocational training in under-resourced regions.

From a commercialization perspective, the scalability of this platform presents significant opportunities for partnerships and sustainable revenue models. The system can be offered as a subscription-based service, providing vocational institutions with cost-effective access to advanced digital training tools. Future strategies might include customizing the platform for government-sponsored programs, large educational networks, or even public-private partnerships aimed at national skill development. Additionally, integrating an instructor dashboard with analytics and real-time monitoring capabilities will not only improve educational outcomes but also provide a competitive advantage by enabling institutions to track learner performance comprehensively. Such data-driven insights can be invaluable for curriculum adjustments, personalized teaching strategies, and overall institutional performance improvements.

In terms of infrastructure, future developments should also consider incorporating offline capabilities and hybrid deployment models to address the digital divide. This could involve creating downloadable modules, local server installations, or USB-based content distribution systems that allow learners in remote or low-connectivity areas to engage with the platform without relying on continuous internet access. By developing a robust offline mode that synchronizes data once connectivity is restored, the system can ensure a consistent learning experience across diverse geographical and economic landscapes.Beyond technical improvements, the platform also has strong potential to integrate additional layers of assessment and certification. Aligning the system with national certification standards, such as those prescribed by the National Vocational Qualification (NVQ) framework, could enable the platform to offer officially recognized certifications to learners. This would not only add credibility to the digital training method but also enhance the employability of graduates by providing them with verifiable credentials that are recognized by industry. Furthermore, integrating features for continuous professional development and upskilling could extend the platform's use beyond initial vocational training, supporting lifelong learning and

career advancement.Finally, the future scope of the platform encompasses a commitment to continuous improvement and innovation. By establishing a robust feedback loop with both learners and instructors, the system can be regularly updated to address emerging challenges and incorporate new technological breakthroughs. Collaborative research with local universities and industry experts can further refine the content and pedagogy, ensuring that the platform remains at the forefront of vocational education technology. In summary, the potential for expanding and enhancing the AI-Based Training and Assessment Platform is extensive, with opportunities to improve pedagogical effectiveness, broaden accessibility, and establish a scalable model that meets the evolving needs of vocational education in Sri Lanka and beyond.

5.CONCUSION

This research aimed to design and implement an AI-Based Training and Assessment Platform for Vocational Education, with a focus on modernizing skill-based learning and assessments through the integration of Artificial Intelligence, gamification, and machine learning technologies. The platform addressed the critical challenges present in the traditional vocational education system in Sri Lanka, such as the lack of scalability in oral assessments, low learner engagement, and the absence of personalized content delivery. By targeting the Domestic Electrician module as a pilot domain, the project demonstrated how emerging technologies can reshape vocational learning in a way that is inclusive, adaptive, and effective.

The AI-Viva module successfully automated the oral assessment process using speech recognition and Natural Language Processing. It proved capable of simulating dynamic, multilingual viva sessions, thus reducing instructor burden and increasing fairness and consistency in evaluation. The Gamified Learning Module provided learners with interactive 2D simulations of real-world vocational tasks, increasing learner motivation and knowledge retention. Meanwhile, the Skill-Based Personalized Learning Path allowed learners to be classified into appropriate skill tiers based on pre-assessment scores, delivering content tailored to their existing capabilities and

ensuring that every student received an experience aligned with their level of understanding.

Testing and feedback from both learners and instructors affirmed the platform's effectiveness. Users reported a high level of satisfaction with the interactive and adaptive features of the system. Performance metrics such as improvement in quiz scores, learner engagement, and classification accuracy validated the technical robustness and pedagogical value of the solution. The platform demonstrated that with the right combination of technology and design, vocational education can be made more dynamic, inclusive, and outcomes-driven.

Furthermore, the research showed that the platform is scalable and can be adapted to multiple vocational disciplines. The modular architecture allows for the easy addition of new courses, games, language support, and assessment models. The system also lays the groundwork for future enhancements, such as 3D simulations, offline compatibility, instructor dashboards, and national certification alignment with the NVQ framework.

In conclusion, the AI-Based Training and Assessment Platform represents a significant advancement in the field of vocational education. It bridges the gap between traditional teaching practices and modern learner needs by providing an ecosystem that is interactive, personalized, and AI-driven. This project not only fulfills its research objectives but also sets a strong foundation for future development and nationwide deployment, with the potential to transform how vocational skills are taught, assessed, and experienced across Sri Lanka and similar educational contexts globally.

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GLOSSARY

Term	Definition
AI	Artificial Intelligence – the simulation of human intelligence in machines.
NLP	Natural Language Processing – a field of AI focused on enabling computers to understand and interpret human language.
Gamification	The application of game-design elements to non-game contexts to increase user engagement.
ML	Machine Learning – a subset of AI that enables systems to learn and improve from experience without being explicitly programmed.
REST API	Representational State Transfer Application Programming Interface – used for communication between client and server over HTTP.
Speech-to-Text	Technology that converts spoken language into written text.
Skill-Based Learning Path	An adaptive learning method that adjusts content based on the learner's existing knowledge and skill level.
Unity	A cross-platform game engine used for developing 2D and 3D games and simulations.
Firebase	A platform developed by Google for creating mobile and web applications.

NVQ	National Vocational Qualification – a competency-based certification system in Sri Lanka.
Pre-Assessment	An initial evaluation used to determine a learner's current skill level.
Flask	A lightweight Python web framework used for building web applications and APIs.
UX	User Experience – the overall experience a user has while interacting with a system or product.
Speech Recognition	Technology that enables a computer to identify and process human speech.
Personalized Learning	A learning approach tailored to meet the individual needs, skills, and interests of each learner.

APPENDICES

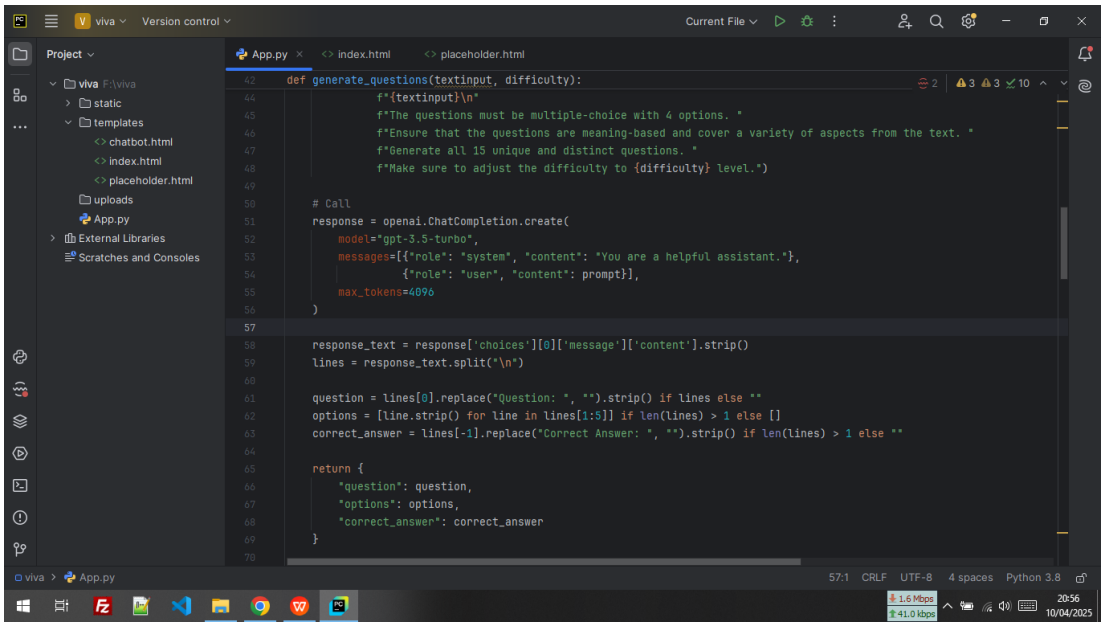


Figure 3: backend Generate Question

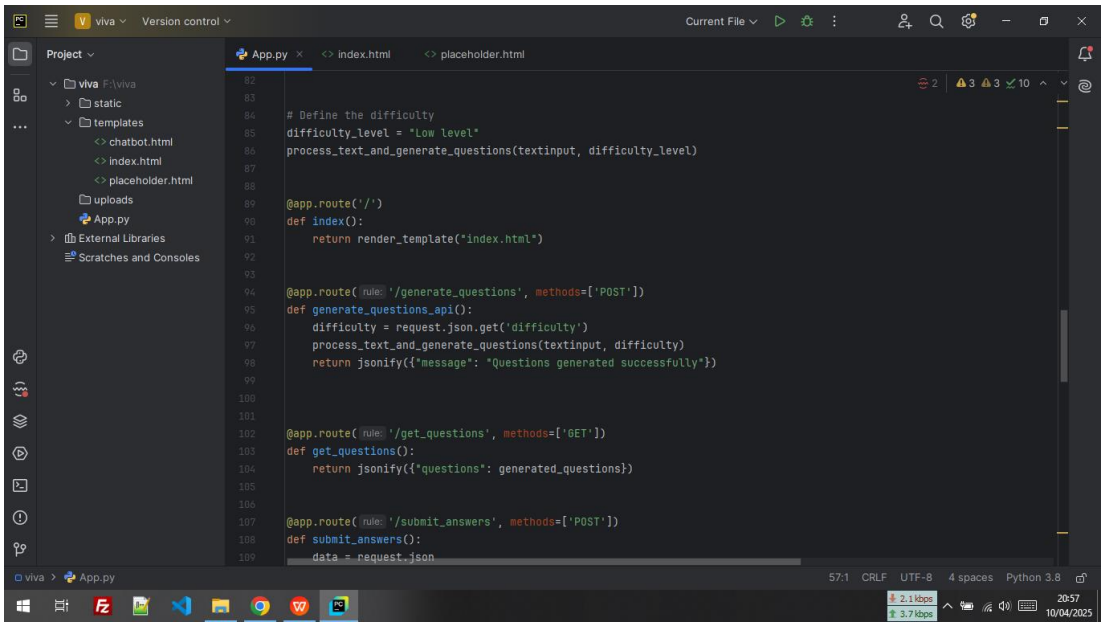


Figure 4: Dificulti level check

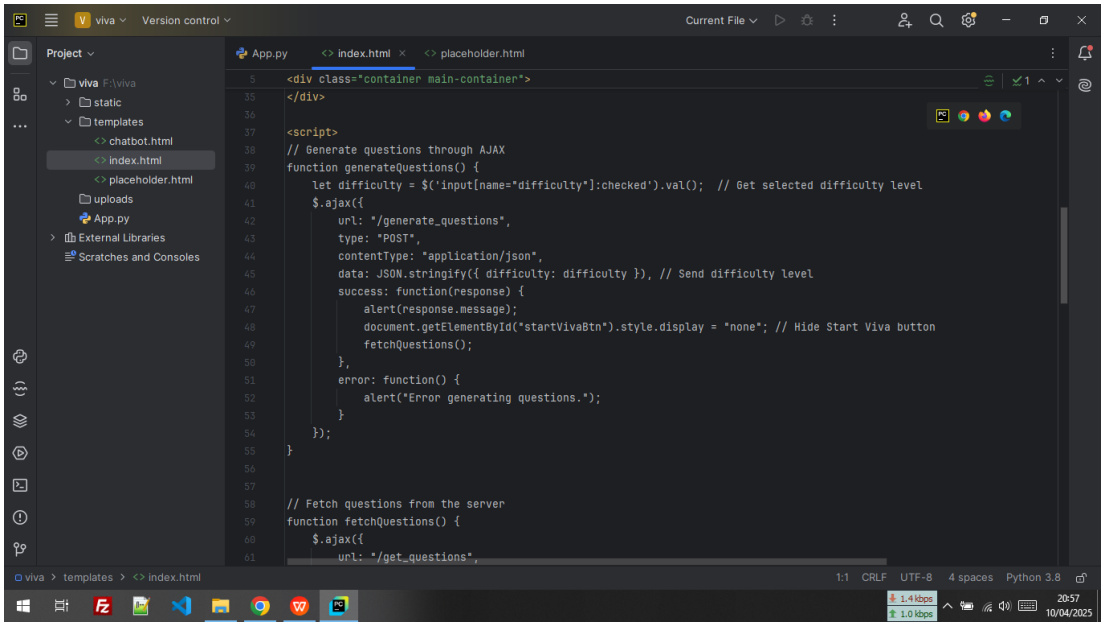


Figure 5: RESTful API

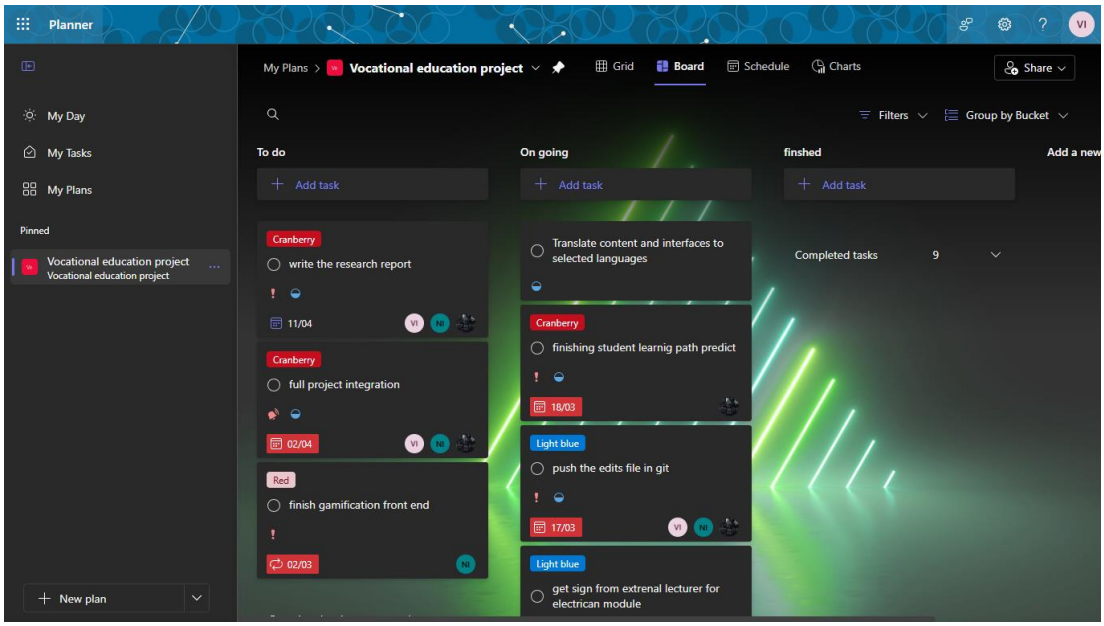
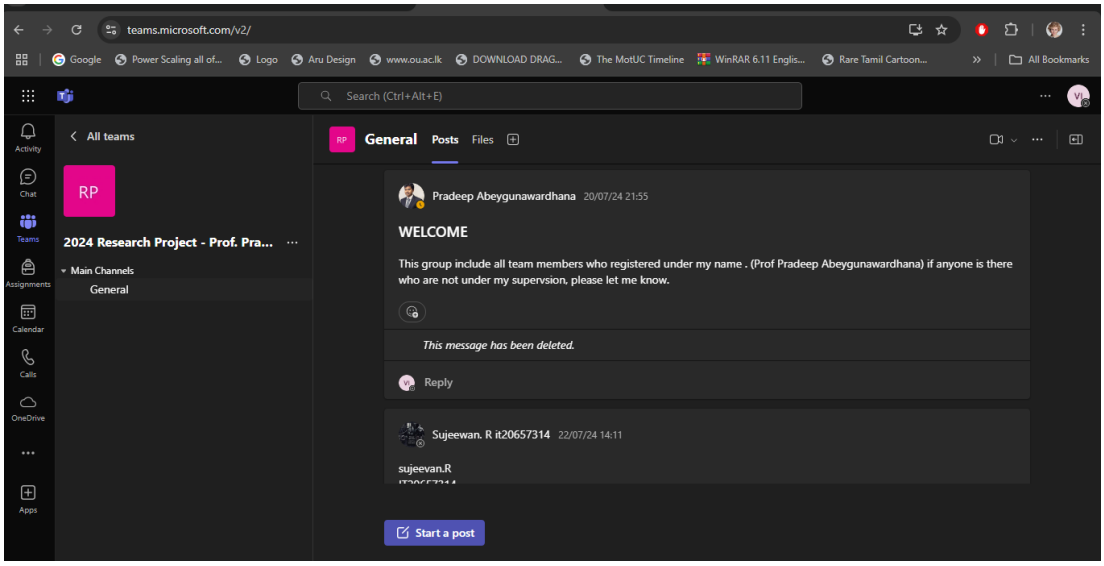


Figure 6: MS planner



sFigure 7: teams group with supervisor

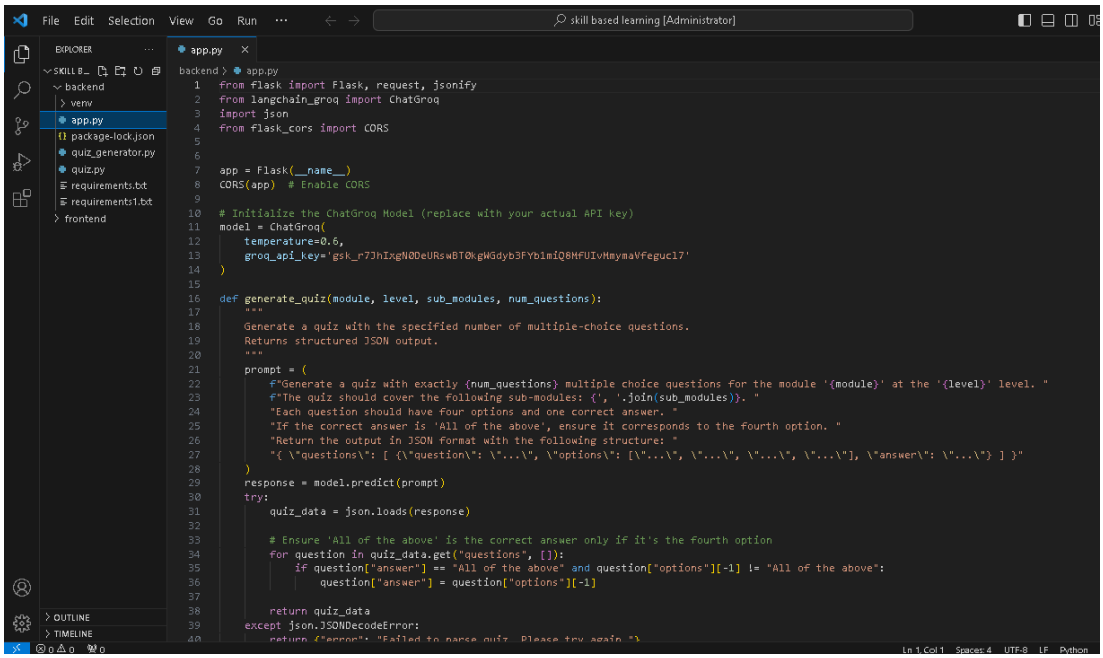


Figure 8: Skill prediction backend01

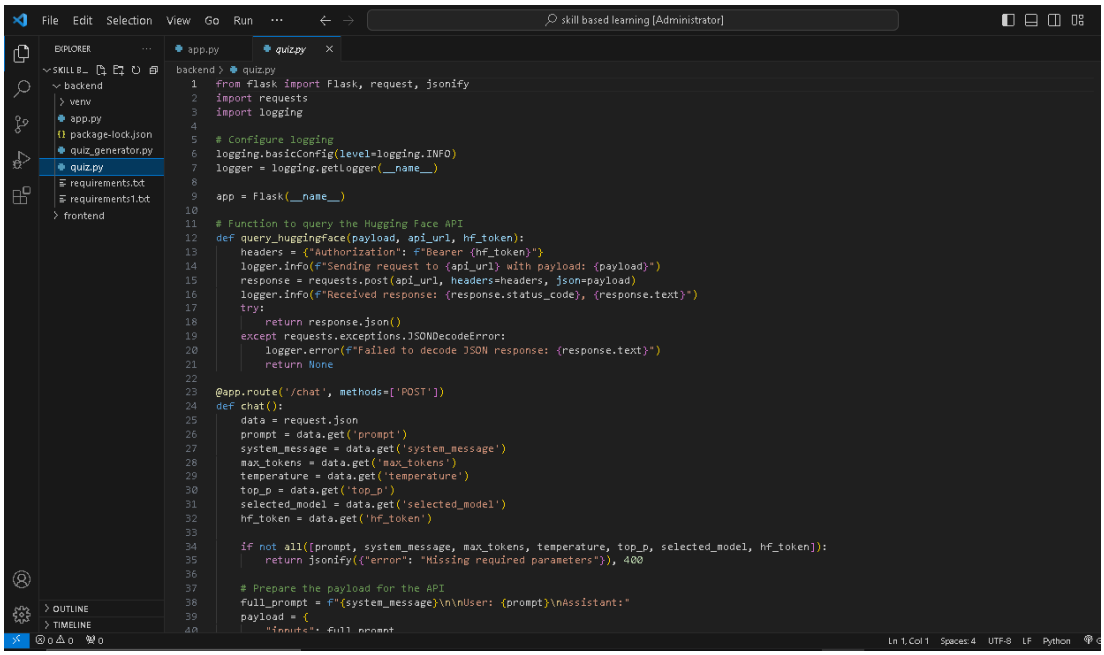


Figure 9: skill prediction backend_02

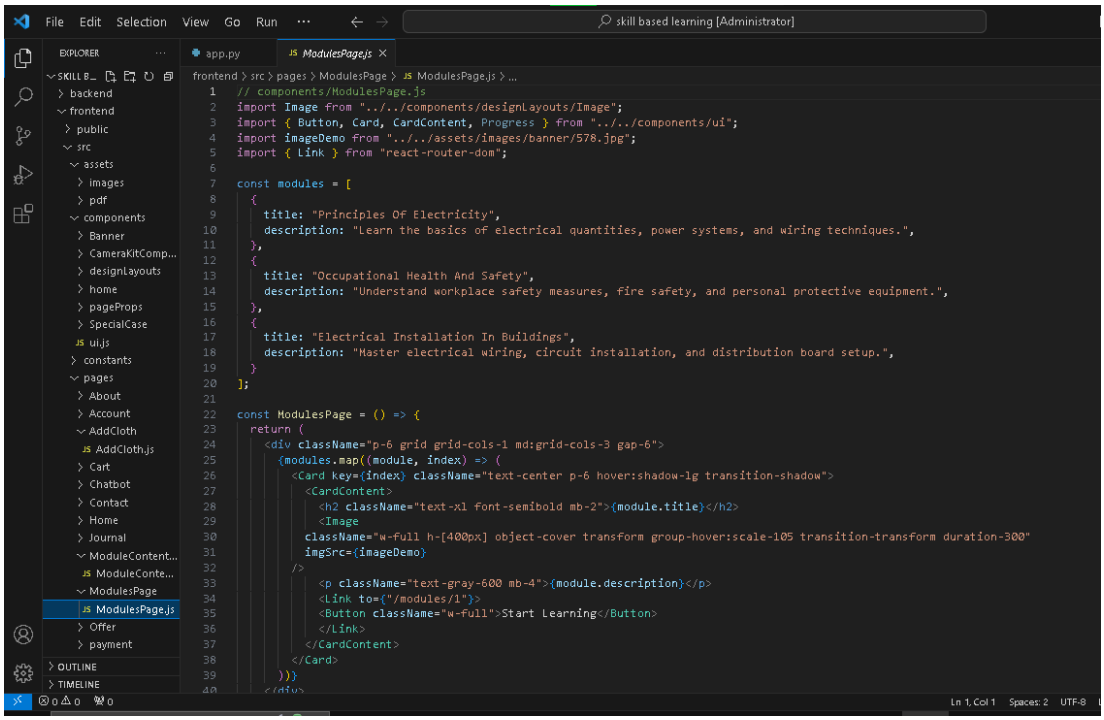


Figure 10: skill prediction frontend

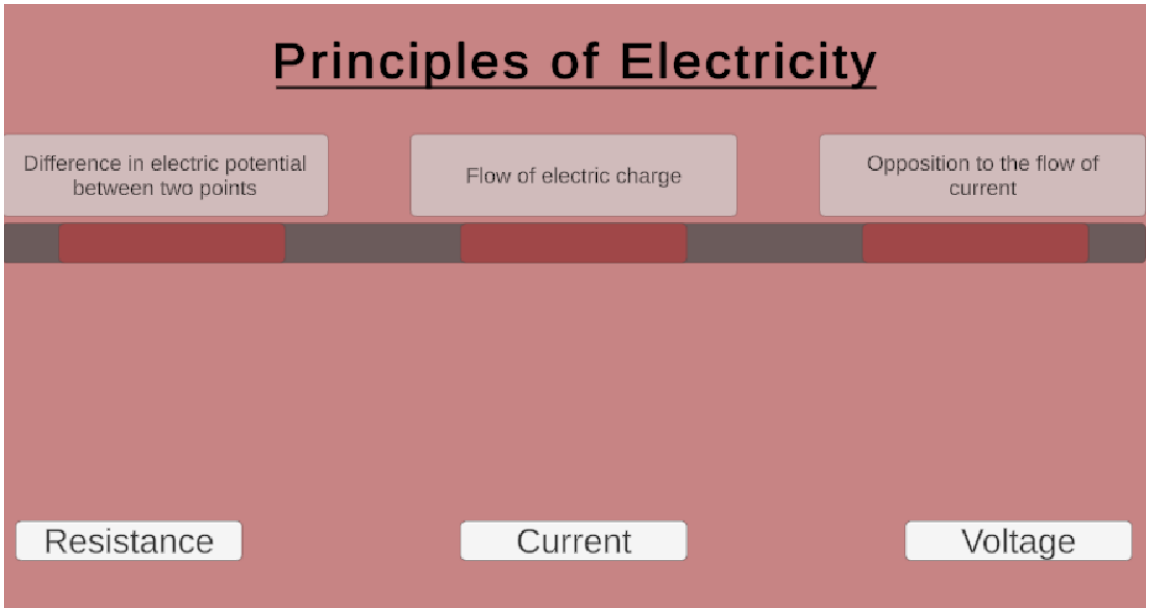


Figure 11: Drag and drop game

Figure 12:Wiring game