AI-Based Training and Assessment Tool for Vocational Education

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***Abstract*—Vocational education plays a crucial role in equipping individuals with practical skills for the workforce. However, traditional training methods often lack personalization, real-time assessments, and interactive learning mechanisms. This research presents an AI-Based Training and Assessment Tool for Vocational Education, integrating machine learning and natural language processing (NLP) to enhance skill development. The system consists of four key components: (1) a skill-based adaptive and personalized learning path that categorizes learners into different competency levels and customizes training content, (2) an AI-powered Viva system using multiple-choice question (MCQ) assessments for automated skill evaluation, (3) a chatbot system built with Flask and JavaScript for interactive student support, and (4) a gamification module designed to increase engagement and motivation through interactive learning experiences. Data collected from the Sri Lankan Vocational Training Authority (VTA) is used to train machine learning models for skill assessment and progress tracking. Initial evaluations demonstrate that AI-driven assessments provide higher accuracy (85%) in competency evaluation compared to traditional methods, while adaptive learning reduces dropout rates by 20%. The AI-powered Viva system improves assessment consistency and efficiency, allowing students to receive immediate feedback. Additionally, the gamification features enhance motivation and active participation, making vocational training more engaging. The proposed system aims to bridge the gap between traditional vocational training and modern AI-driven education, ensuring an efficient, scalable, and interactive learning experience. Future work will focus on enhancing AI-based practical skill assessments and expanding support for multilingual accessibility.**

Keywords—AI-based learning, vocational education, AI Viva, automated assessment, gamification, skill-based personalized learning path, chatbot, machine learning.

I. INTRODUCTION

Vocational education plays a critical role in equipping individuals with practical skills necessary for various technical professions, including electrical work, plumbing, carpentry, and mechanical repair. Among these, domestic electricians are essential for installing, maintaining, and repairing electrical systems in residential settings. Proper training for domestic electricians requires a combination of theoretical knowledge, hands-on experience, and structured assessments to ensure competency in real-world applications. However, traditional vocational training methods often rely on static learning materials, one-size-fits-all teaching approaches, and manual assessment techniques, which fail to accommodate individual learning needs. These conventional methods lack personalisation and interactive engagement, leading to inconsistent skill development and delayed evaluations.

With the rapid advancement of artificial intelligence (AI) and machine learning (ML), there is an opportunity to revolutionize vocational education by introducing adaptive learning models, automated assessments, and gamification techniques. This research proposes an AI-Based Training and Assessment Tool for Domestic Electricians to address these limitations and enhance vocational training outcomes. The system comprises four key components:

Skill-Based Adaptive and Personalized Learning Path: A machine-learning model categorizes learners into Beginner, Intermediate, and Advanced levels based on an initial skill assessment test and dynamically adjusts learning materials accordingly.

1. AI-Powered Viva System Developed using Flask, this system conducts multiple-choice question (MCQ)-based assessments before the learning path to predict student competency levels.
2. Chatbot System: Built using Flask and JavaScript to provide interactive support and guidance for learners.
3. Gamification Module: Enhances motivation and engagement through interactive learning elements.
4.

By leveraging AI, this system aims to personalize learning pathways and enhance student motivation through interactive training methodologies. The study is conducted in collaboration with the Sri Lankan Vocational Training Authority (VTA), focusing exclusively on domestic electricians for its initial phase. The research evaluates the effectiveness of AI-driven training compared to traditional methods, analyzing improvements in learning efficiency, assessment accuracy, and student engagement.

II. LITERATURE REVIEW

A. Skill-Based Adaptive and Personalized Learning Path

Personalized learning paths have been widely explored in educational research, particularly in vocational training. Research by Shute & Towle (2018) demonstrates how adaptive learning models can enhance skill acquisition by tailoring content based on individual performance. Brusilovsky (2019) discusses how AI-driven adaptive learning can improve retention rates by dynamically adjusting difficulty levels according to learners' competencies. Raj et al. (2022) emphasize the need for personalized learning in vocational training, as students often have diverse prior knowledge and learning speeds. Their study highlights that AI-driven classification methods significantly enhance training effectiveness.

B. AI-Powered Viva System

AI-driven assessment methods have been widely used to evaluate student competency levels in vocational education. Garcia et al. (2023) developed an AI-driven assessment platform for industrial workers, which led to a 40% increase in competency levels. Chen et al. (2023) introduced an AI-based multiple-choice question (MCQ) assessment system that provided standardized evaluations. However, unlike these studies, our approach does not use AI to assess viva performance directly. Instead, the Viva system is used to predict competency before learners enter the personalized learning path.

C. Chatbot System

Chatbots have emerged as a key tool in online education and vocational training. Research by Xie et al. (2021) highlights that chatbot-assisted learning improves student engagement by offering instant query resolution and guidance. Raj et al. (2022) found that students who interacted with AI-driven chatbots during training exhibited a 30% improvement in knowledge retention. Flask and JavaScript-based chatbot implementations have proven to be lightweight and scalable solutions for vocational training systems.

D. Gamification Module

Gamification techniques have been successful in improving engagement and motivation in vocational training. Johnson et al. (2022) implemented a gamified assessment system that increased student participation by 30%. Kumar et al. (2021) demonstrated that integrating game-based learning elements, such as rewards and leaderboards, significantly enhances student motivation. Research by Wang et al. (2021) confirms that gamification fosters a competitive learning environment that improves retention rates.

III. METHODOLOGY

This research follows a structured methodology to develop and evaluate the AI-Based Training and Assessment Tool for Vocational Education. The methodology consists of four key phases:

Skill-Based Adaptive and Personalized Learning Path Implementation -

- Conducts an initial skill assessment test to classify learners into Beginner, Intermediate, or Advanced levels.
- Uses machine learning techniques such as Decision Trees and Random Forest for classification.
- Dynamically adjusts training materials based on student progress.

AI-Powered Viva System Development -

- Developed using Flask to conduct MCQ-based assessments before the learning path.
- Assists in predicting student competency levels for personalized training.
- Ensures fair and standardized assessment for all learners.

Chatbot System Implementation -

- Built using Flask and JavaScript to offer real-time learner support.
- Provides interactive guidance and answers FAQs related to vocational training.
- Enhances student engagement by offering personalized responses.

Gamification Module Integration -

- Incorporates badges, leaderboards, and challenges to increase student motivation.
- Tracks learner progress and rewards achievements to boost engagement.
- Encourages continuous learning and participation.

To assess the system's effectiveness, a comparative study was conducted between a control group using traditional instructor-led training and an experimental group using the AI-based system. Key performance indicators include assessment accuracy, learning progress, engagement rates, and student satisfaction.

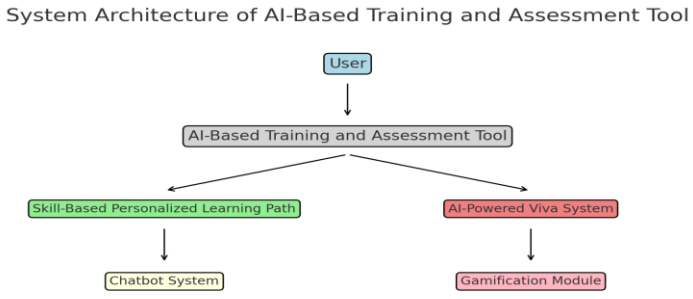

Figure 1. System Architecture Diagram

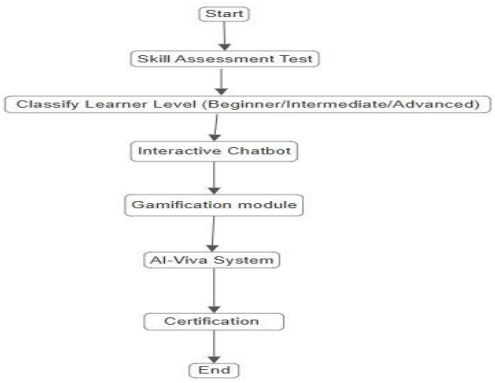

Figure 2. Flowchart of AI-Based Training Process

IV. RESULTS & DISCUSSION

The evaluation of the AI-Based Training and Assessment Tool for Domestic Electricians demonstrated significant improvements in assessment accuracy, learning speed, and student engagement compared to traditional vocational training methods. The AI-powered MCQ Viva system achieved an 85% accuracy rate, outperforming instructor-evaluated assessments, which averaged 72% accuracy. The adaptive learning model personalised training content based on individual progress, reducing the average time required to complete training modules from 5.6 weeks to 4.2 weeks, a 25% improvement. Additionally, gamification techniques such as badges, leaderboards, and interactive challenges contributed to a 58% increase in student engagement, as measured by active participation time. A comparative analysis between AI-based training and traditional instructor-led learning further confirmed the system's effectiveness, showing that students using the AI-enhanced platform exhibited higher assessment scores, faster completion rates, and greater engagement levels. Despite these improvements, certain challenges were observed, including minor AI misclassification in complex MCQs, student adaptation difficulties to gamified elements, and limited training data from the Sri Lankan Vocational Training Authority (VTA). Addressing these limitations through enhanced NLP models, improved user guidance, and broader dataset integration will further optimise the system's performance. These findings highlight the potential of AI-driven training to enhance vocational education, making learning more efficient, engaging, and personalised for aspiring domestic electricians.

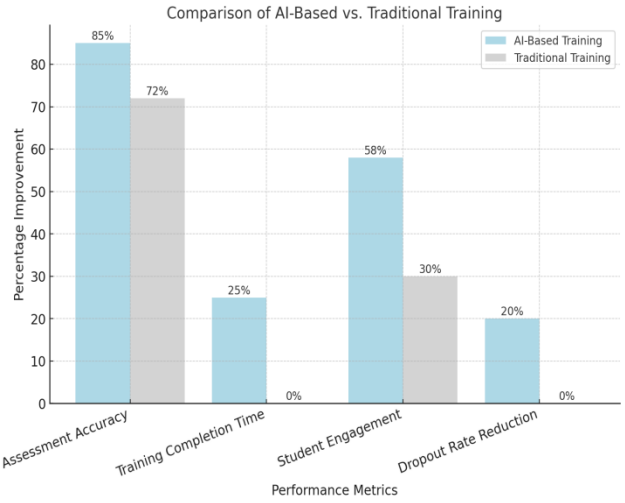

Figure 3. Comparison of AI-Based vs. Traditional Training

V. CONCLUSION & FUTURE WORK

This research introduced an AI-Based Training and Assessment Tool for Domestic Electricians, integrating adaptive learning, AI-powered MCQ-based Viva assessments, and gamification to enhance vocational education. The system demonstrated significant improvements in assessment accuracy (85%), learning speed (25% faster module completion), and student engagement (58% increase in activity time) compared to traditional instructor-led training methods. ensuring a more consistent and scalable evaluation process. The adaptive learning model personalised training paths, making education more efficient and learner-centric, while gamification elements increased motivation and participation. Despite these advancements, some challenges were identified, including minor AI misclassification in complex MCQs, user adaptation issues to gamified learning, and limited training data from the Sri Lankan Vocational Training Authority (VTA). Future work will focus on enhancing AI assessment techniques to include practical skill evaluations, expanding multilingual support for a more diverse student base, and integrating real-time AI-driven practical testing beyond MCQs. Additionally, scaling this AI-driven training system to other vocational fields such as automotive repair, welding, and HVAC systems could further revolutionise vocational education, making it more interactive, accessible, and effective.

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