AI – BASED TRAINING AND ASSESMENT TOOL FOR VOCATIONAL EDUCATION

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Specializing in Information Technology

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Dissertation submitted in partial fulfillment of the requirements for the Bachelor of Science (Hons) in Information Technology Specializing in Information Technology

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DECLARATION OF THE CANDIADATE & SUPERVISOR

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We declare that this is our own work, and this proposal does not incorporate without acknowledgment any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of our 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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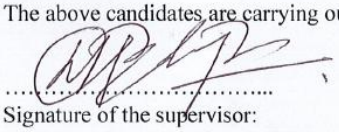
The above candidates are carrying out research for the undergraduate Dissertation under my supervision.



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Signature of the supervisor:
Prof. Pradeep Abeygunawardhana

11/04/2025

Date:

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ABSTRACT

This paper presents the design and development of a Unity-based gamified training and assessment system tailored for vocational education, emphasizing the integration of game-based learning (GBL) to enhance engagement and skill acquisition. In traditional vocational training environments, challenges such as limited hands-on opportunities and a lack of adaptive learning methods can hinder student progress. This project addresses those gaps by creating an interactive where learners can practice core vocational tasks in a virtual setting.

Built using Unity, the system features drag-and-drop mechanics, realistic task scenarios, and instant feedback mechanisms to replicate real-world skill application in a safe and repeatable digital environment. Gamification elements—including progress tracking, scoreboards, rewards, and visual cues—are embedded to boost learner motivation and sustain engagement throughout the training journey. These features make the learning process more intuitive and enjoyable, especially for beginners and students who benefit from visual and interactive learning.

The tool also includes adaptive assessment features, allowing instructors to monitor student performance and adjust difficulty levels or learning paths based on real-time progress. This promotes personalized learning experiences and ensures that the feedback provided aligns with each learner's strengths and areas for improvement.

Overall, the Unity-based gamified system offers a scalable and effective solution to modernize vocational training. By merging interactive technology with pedagogical best practices, it enhances the quality of education, increases learner confidence, and prepares students for hands-on professions in a rapidly evolving workforce. The broader impact of this tool suggests a promising shift toward more engaging, adaptable, and skill-focused vocational learning environments.

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LIST OF ABBREVIATIONS

Abbreviation	Descriptions
GBL	Game Based Learning
AI	Artificial Intelligence
NLP	Natural Language Processing
ML	Machine learning

1. INTRODUCTION

1.1 Background & Literature survey

Vocational education is a critical component of the educational landscape, designed to equip learners with practical skills and knowledge directly applicable to specific trades and professions. Fields such as electrical engineering require hands-on experience, technical proficiency, and a deep understanding of industry-specific challenges. Traditional teaching methods, which often rely on lectures, textbooks, and manual assessments, may not fully engage students or adequately prepare them for the complexities of the modern workforce.

In recent years, there has been a growing recognition of the potential for advanced technologies, particularly artificial intelligence (AI) and digital learning tools, to transform vocational education. When combined with gamification and game-based learning (GBL), AI can significantly enhance the learning experience, making it more interactive, engaging, and effective.

Gamification involves incorporating game elements such as points, badges, leaderboards, and challenges into educational content, while GBL uses actual game-based scenarios to teach specific skills and concepts. Both approaches are designed to increase student motivation, participation, and retention by making learning activities more enjoyable and relevant. In vocational education, where practical application is key, gamified and game-based learning environments can simulate real-world tasks in a controlled, risk-free setting, allowing students to practice and master essential skills before applying them in the workplace.

Despite the recognized benefits, the integration of AI-driven gamification and GBL in vocational education is still in its nascent stages. There is a need for comprehensive tools that not only deliver engaging content but also provide accurate assessments of student performance and skill mastery. An AI-based training and assessment tool that leverages

these innovative educational approaches has the potential to revolutionize how vocational education is delivered, ensuring that students are better prepared for the demands of their chosen professions.

This report explores the development of such an AI-based tool tailored for vocational education, focusing on the fields of electrical engineering. It discusses the tool's design, functionality, and the benefits it offers to both learners and educators, including personalized learning paths, real-time analytics, and interactive simulations that mirror real-life industry challenges. By addressing the limitations of traditional methods and leveraging the strengths of AI and gamification, this tool aims to enhance the effectiveness of vocational education and better prepare students for success in their careers.

Literature Review:

The integration of technology into education has been a subject of extensive research over the past few decades, particularly with the rise of digital learning tools and artificial intelligence (AI). Vocational education, which traditionally relies heavily on hands-on, practical learning, has also gained increasing attention regarding how these technologies can be applied to improve training outcomes and better prepare students for the workforce. This literature survey explores key studies and advancements related to AI-based training, gamification, and game-based learning (GBL) within the context of vocational education.

1. Artificial Intelligence in Education:

AI has been widely recognized for its potential to revolutionize education by providing personalized learning experiences. Numerous studies have demonstrated how AI can tailor educational content to individual learning styles and paces, resulting in improved student engagement and outcomes. AI can facilitate more accurate assessments by analyzing a wide range of student data to measure skill acquisition and mastery, which is particularly valuable in practical, skills-based learning environments.

2. Gamification in Education:

Gamification involves the application of game design elements in non-game contexts, and its effectiveness in education has been well-documented. Research shows that gamification can significantly increase student motivation, engagement, and participation by making learning activities more interactive and enjoyable. In vocational education, gamification can simulate real-world tasks and challenges in a controlled environment, allowing students to gain practical experience without the risks associated with real-life situations. Gamification also fosters a competitive yet collaborative learning atmosphere, encouraging students to strive for excellence while working together.

3. Game-Based Learning (GBL):

Game-based learning (GBL) takes the principles of gamification further by using actual games as the primary medium for teaching and learning. GBL has been shown to be particularly effective in developing critical thinking, problem-solving, and decision-making skills. Various studies have explored how GBL can be used in vocational education to create immersive learning experiences where students learn by doing. This approach enhances knowledge retention and helps students apply theoretical concepts in practical scenarios, which is crucial in fields like electrical engineering and automotive mechanics. GBL also allows for iterative learning, where students can repeat tasks or scenarios multiple times until they achieve mastery.

4. Integration of AI, Gamification, and GBL:

The convergence of AI, gamification, and GBL represents a powerful approach to vocational education, offering a holistic learning experience that is both engaging and

effective. Research has explored how these technologies can be integrated to create adaptive learning environments that respond to student needs in real-time. AI enhances gamified and game-based learning by providing personalized content and feedback, while gamification and GBL make learning more interactive and enjoyable. This combination not only improves skill acquisition but also prepares students for the real-world challenges they will face in their careers.

5. Challenges and Opportunities:

While the benefits of AI, gamification, and GBL in vocational education are clear, several challenges remain. One significant challenge is the need for scalable solutions that can be easily implemented across diverse educational settings. Additionally, there is an ongoing need to refine these technologies to ensure they align with industry standards and educational goals. However, the opportunities presented by these innovations are vast, offering the potential to transform vocational education by making it more relevant, engaging, and effective.

Conclusion:

The literature reviewed underscores the significant impact that AI, gamification, and GBL can have on vocational education. These technologies offer innovative solutions to the challenges of traditional educational methods, particularly in preparing students for

the practical demands of careers in fields like electrical engineering and automotive mechanics. As research continues to evolve, there is a growing consensus that the integration of AI-driven gamified and game-based learning tools represents the future of vocational education, providing learners with the skills and knowledge they need to succeed in a rapidly changing job market. This literature survey sets the stage for developing an AI-based training and assessment tool for vocational education, which will

incorporate best practices and insights from existing research while addressing the specific needs of learners and educators in the vocational training sector.

1.2 Research Gap

- Limited Integration of AI with Gamification in Vocational Education:

There is a lack of comprehensive tools that effectively combine AI with gamification specifically tailored for vocational training in fields like electrical and automotive engineering.

- Inadequate Real-World Scenario Simulations:

Existing platforms often fall short in providing realistic and industry-relevant virtual scenarios that adequately prepare students for practical challenges in the workforce.

- Insufficient Personalized Learning Paths:

Current vocational education tools do not fully leverage AI to create adaptive, personalized learning experiences that cater to the diverse needs and skill levels of students.

- Lack of Robust Progress Tracking and Feedback Mechanisms:

There is a need for more advanced systems that offer real-time tracking of student progress and provide actionable feedback to both learners and instructors.

- Challenges in Collaborative Learning Integration:

Existing gamified learning tools often do not adequately support team-based challenges and effective communication among learners, which are crucial for developing workplace skills.

Features	Current available system	Proposed System
2d gamified setup for usage		
Avatar and gamified concept		
Context-Aware Collaborative Learning		

Figure1: Research Gap Table

1.3 Research Problem

The research problem addressed in this study is the need for an innovative and effective approach to vocational education that better prepares students for the practical demands of their careers in fields such as electrical engineering and automotive mechanics. Traditional vocational training methods, which rely heavily on lectures, textbooks, and manual assessments, often fail to fully engage students or provide them with the real-world experience needed to succeed in modern industries. While gamification and game-based learning (GBL) have shown promise in enhancing student engagement and skill acquisition, their application in vocational education remains underdeveloped. Additionally, the integration of artificial intelligence (AI) to create personalized learning experiences, provide real-time feedback, and simulate realistic industry scenarios is still in its early stages. This research seeks to address these gaps by developing an AI-based training and assessment tool that leverages the strengths of gamification and GBL to create a more interactive, engaging, and effective learning environment for vocational students.

1.4 Research Objectives

1.4.1 Main Objectives

The primary objective of this research is to design and develop a series of simple, interactive 2D educational games tailored for students who are interested in pursuing a career as electricians. The focus of the project is to use game-based learning as a tool to introduce and reinforce foundational concepts in the electrical trade, including safety procedures, circuit design, tool identification, basic wiring techniques, and problem-solving in electrical systems.

By incorporating elements of gamification—such as challenges, rewards, levels, and feedback—the games aim to increase student engagement, motivation, and retention of key knowledge. The research also seeks to explore how digital game environments can simulate real-world electrical scenarios in a safe and controlled way, thereby helping students build confidence and practical understanding before entering hands-on training.

Additionally, the project aims to evaluate the effectiveness of 2D game-based learning in vocational education through user testing and feedback. This includes analyzing how such games can support diverse learning styles, improve accessibility, and potentially reduce early-stage dropout rates in technical training programs. The final goal is to provide an innovative, learner-friendly educational tool that can complement traditional methods and enhance the overall quality of electrician training.

1.4.2 Specific Objectives

1. Identify and Gamify Key Concepts in Electrical Systems

Thoroughly analyze the essential concepts and skills required in the fields of electrical systems. Based on this analysis, identify the most critical and challenging topics that can be effectively transformed into gamified content. The goal is to create engaging and interactive learning experiences that make complex technical concepts easier to understand and retain, ensuring that learners can apply these skills confidently in real-world scenarios.

2. Develop Interactive Modules with Quizzes and Games:

Design and develop interactive learning modules that incorporate a variety of quizzes, puzzles, and memory games. These modules will be structured to reinforce the key

concepts identified, providing students with opportunities to test their knowledge and receive instant feedback. The interactive nature of these modules is intended to enhance student engagement, promote active learning, and improve knowledge retention.

3. Implement a Dynamic Point-Based Scoring System

Integrate a point-based scoring system within the games to incentivize learning and reward performance. Points will be awarded based on the accuracy and speed of responses, encouraging students to think critically and act quickly. This system aims to introduce a competitive yet supportive learning environment that motivates students to improve their performance, track their progress, and stay engaged throughout the learning journey.

1.4.3 Business Objectives

1. **Enhance the Appeal of Vocational Training through Innovation**
   Utilize interactive 2D games as a modern, engaging method to attract more students to vocational fields like electrical work. By making learning fun and interactive, this project aims to increase enrollment and interest in electrician training programs.
2. **Increase Student Retention and Course Completion Rates**
   Address high dropout rates often found in technical courses by improving student engagement and satisfaction through gamified learning. The goal is to keep learners motivated and reduce early-stage disengagement.
3. **Offer a Scalable Educational Product for Institutions and Training Centers**
   Develop a digital solution that can be easily adopted by vocational institutes, schools, and training centers. The modular nature of the games allows them to be integrated into existing curricula or used as supplementary training tools.
4. **Create Opportunities for Revenue Generation through Licensing or Subscriptions**
   Explore commercial opportunities by offering the game platform under licensing

models or as a subscription-based service for educational institutions, potentially generating sustainable revenue for ongoing development and updates.

5. **Strengthen the Institution's Brand as a Leader in Educational Technology** Position the development team or educational institution as a forward-thinking, innovative contributor to vocational education. This reputation can attract partnerships, funding, and recognition in the field of EdTech.
6. **Gather Market Insights and Feedback for Future Product Expansion** Use student and instructor feedback to evaluate user experience and market demand, providing valuable insights for the development of future games in other vocational areas (e.g., plumbing, automotive, carpentry).

2. METHODOLOGY

2.1 Methodology

The methodology for developing the AI-Based Training and Assessment Tool for Vocational Education begins with detailed system design and planning. This stage involves outlining the system architecture, focusing on the integration of key components such as the Gamified Learning Modules. Each module is defined with specific user and technical requirements in mind.

The development process starts with creating the gamified learning modules, which include interactive quizzes, puzzles, and games tailored to electrical systems and automotive mechanics. These modules are iteratively refined through testing and feedback. Next, the Virtual Scenario Engine is implemented to simulate realistic industry challenges, with AI-driven features that adapt scenarios based on user performance. Industry experts are consulted to ensure the scenarios are accurate and relevant.

The methodology then focuses on integrating a collaborative learning platform that facilitates team-based challenges and communication among learners. This platform is

tested to ensure it effectively promotes teamwork and interaction. Concurrently, a robust progress tracking system is developed, incorporating AI-powered analytics to provide real-time feedback and generate detailed performance reports for instructors.

Backend services and security measures are implemented to support the platform's functionality. This includes the development of the AI engine, database, and security protocols to protect user data. Comprehensive testing is conducted to ensure the platform's usability, performance, and scalability across multiple devices and platforms.

After testing, the platform is deployed in a controlled environment, with initial users receiving training and support. User feedback and system analytics guide further refinement. The methodology concludes with a focus on continuous improvement and maintenance, ensuring the platform remains up to date with industry standards and scalable for future needs. This systematic approach ensures the development of a robust, user-centered training tool that effectively meets the vocational education requirements for electricians and automobile engineers.

2.1.1 Feasibility Study / Planning

This phase assesses the feasibility of implementing an AI-powered training and assessment tool that leverages gamification and game-based learning to enhance student engagement and knowledge retention in vocational education. The study focuses on technical, economic, legal, operational, time/schedule, and social aspects to evaluate the practicality and effectiveness of developing and deploying this system, particularly for students pursuing careers such as electricians.

1. Technical Feasibility

- **Content and Curriculum Alignment**: The research began by identifying core vocational concepts—such as electrical safety, basic wiring, and circuit logic—that are essential for early-stage learning. These were mapped to national

vocational qualification (NVQ) frameworks to ensure content relevance and applicability.

- **Game Development Tools**: The system was developed using Unity for building 2D games, which offers cross-platform deployment and a rich library for interactive educational design. AI-powered feedback and hint systems were built using Python scripts and integrated through APIs to offer adaptive feedback based on student responses.
- **AI Integration**: AI models were employed to monitor player choices and provide context-based tips, track progress, and recommend difficulty adjustments. The backend analytics system uses lightweight machine learning algorithms for real-time data collection and decision-making.
- **Platform Requirements**: Development and deployment required a mid-range PC or laptop, Unity IDE, Python environment, and Firebase for storing performance data. The front end of the learning platform was web-based for broader accessibility.

2. Economic Feasibility

- **Budget Allocation**: The budget was mainly allocated for software licenses, internet services, cloud data hosting (Firebase), development tools, and content creation assets (icons, sound effects, and animations).
- **Human Resources**: The team included individuals with expertise in game design, educational psychology, AI programming, and user experience (UX) design. The diverse skill set allowed for internal development without the need for external contractors, reducing costs.
- **Return on Investment (ROI)**: The tool has the potential to significantly enhance vocational education by increasing learner engagement and reducing dropout rates. It provides scalable, reusable learning modules that can be updated and reused across multiple courses or institutions, making it cost-effective in the long term.

Table 1 shows the cost management/ economic feasibility of the research.

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 1:Cost Management

3. Legal and Ethical Feasibility

- **Student Data Privacy**: The system only collects anonymized performance data such as scores, completion times, and error rates. No personal data is collected unless explicitly permitted by the user, and all stored data complies with local educational data protection standards.
- **Fair Usage and Licensing**: All visual, audio, and code-based assets used in the development were either original creations or sourced from open-license repositories (e.g., Creative Commons). Proper attribution is given where applicable.
- **Ethical Use of AI**: The AI components were designed to assist rather than replace educators, offering supplementary guidance while ensuring transparency in decision-making and feedback mechanisms.

4. Operational Feasibility

- **Game Module Development**: Interactive mini-games were developed around key topics (e.g., wiring puzzle challenges, tool-matching games) to simulate real-world electrician tasks. Each module was tested for usability and educational value.
- **Deployment Strategy**: The platform is designed for easy deployment in computer labs and on student devices. It supports both offline and online modes, making it adaptable for low-connectivity environments.
- **Assessment Integration**: The tool includes built-in quizzes, a point system, and progress tracking dashboards that help instructors monitor learning outcomes. Feedback loops were integrated using AI scripts that suggest review topics based on quiz performance.

5. Time / Schedule Feasibility

- **Project Timeline**: The project followed an Agile development lifecycle, with clearly defined sprints for content creation, game logic development, AI integration, testing, and user feedback implementation.
- **Milestone Tracking**: Monthly sprints and every couple of months ensured consistent progress. Game design testing was done to avoid delays.

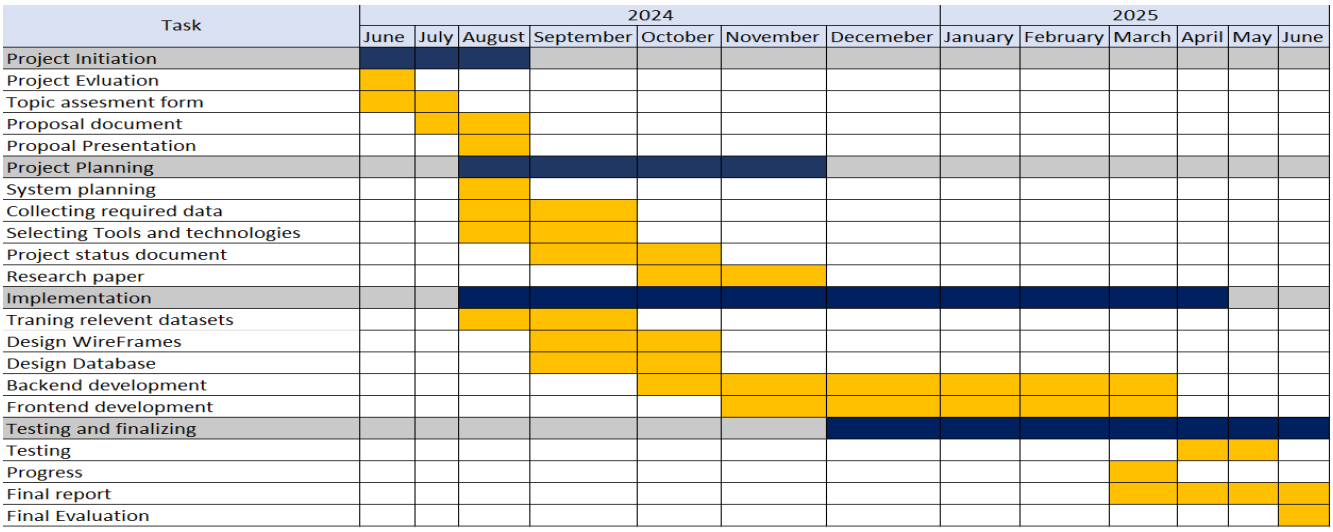

Figure2: Gantt Chart

6. Social and Cultural Feasibility

- **Cultural Relevance**: The game content was designed to reflect vocational tasks relevant to the Sri Lankan context, using familiar tools, environments, and language to increase relatability for students.
- **Accessibility and Inclusiveness**: Efforts were made to design inclusive games suitable for learners with varied educational backgrounds and learning speeds. Colorblind-friendly palettes and localized instructions (Sinhala/Tamil) were considered during UI/UX design.
- **Educational Acceptance**: Feedback from vocational trainers and students indicated strong interest in using interactive tools to supplement traditional teaching. The gamified platform is viewed as a modern and enjoyable way to deliver essential skills training.

Other than these feasibility studies, the risk management plan and communication management plan has been done.

➢ Risk Management Plan

The alternative plans and their specifics are described in the risk management plan mentioned above. The development team will complete its task without interruptions using this strategy. These are the typical threats that a project team encounter. Table 2 shows the risk management plan.

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

Table 1: Risk Management Plan

Communication Management Plan

The communication management plan ensures that all members of the project team, including the supervisor and co-supervisor, receive the necessary information to carry out their responsibilities effectively. The success of the project heavily relies on how well communication is planned and implemented. This plan defines the most effective and efficient ways to engage with various stakeholders. It details the target audience, the content and structure of communication, how often it should occur, and the desired results. Additionally, it identifies each stakeholder's role, the method of task assignment, and a tailored communication approach based on their level of influence, interest, and expectations.

Communication Objectives

Clear and proactive communication is essential throughout the project. Communication should be:

- **Adequate** – delivered in the appropriate format with relevant content.
- **Targeted** – specifically tailored to the intended audience.
- **Comprehensive** – covering all important and necessary information.
- **Clear and concise** – brief and free of unnecessary repetition.
- **Timely** – shared at the appropriate stage or time during the project.

***Communication Media*:**

The project will make use of the following communication tools:

1. Email
2. Documents (Microsoft Word and/or PowerPoint)
3. Phone calls
4. Virtual meetings (Google Meet, Microsoft Teams)
5. Instant messaging (WhatsApp)

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.

Meeting Type	Attendees	Purpose	Frequency	Agenda Items
				* Agree on the process for resolving disputes and propose the escalation method. * 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
Actual Project Status Meeting	Supervisor, All Team Members		*Twice a week*	

Meeting Type	Attendees	Purpose	Frequency	Agenda Items
				progress), New change requests (input from Research Panel) * Next deliverables status: -Existing change requests (Current 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.

Meeting Type	Attendees	Purpose	Frequency	Agenda Items
				*Assessment of the existing situation in relation to the project's objectives, spending plan, and completion date. *Official endorsements, commitments, and contractual details.
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 2: Communication Management Plan

2.1.2 Requirement Gathering & Analysis

The Requirement Gathering and Analysis phase served as the foundation for defining the scope, objectives, and constraints of this research project, which aims to develop an AI-based training and assessment tool with a strong emphasis on gamification and game-based learning for vocational education—specifically targeting students pursuing careers such as electricians.

This phase involved extensive investigation into the educational, technical, and user-experience needs of the target audience. Input was collected from vocational training experts, instructors, students, and educational psychologists to understand both functional and non-functional requirements essential for building an engaging and educational 2D game environment.

Data was also collected from the Vocational education unit in Jaffna. We thank them for their help in giving us their valuable data.

2.1.2.1 Functional Requirements

The functional requirements of the system include the development of interactive 2D games that teach core electrician concepts such as safety procedures, tool identification, and basic wiring techniques. The games must incorporate quizzes, puzzles, and interactive modules that provide immediate feedback. A point-based scoring system should be integrated to reward users based on performance, along with progress tracking features to monitor learner improvement over time.

Interviewing and Observation Methods: To understand the practical challenges and user expectations, informal interviews were conducted with vocational instructors and students currently undergoing electrician training. Observations were also carried out in classroom and workshop settings to assess how theoretical and practical content is delivered. These methods revealed a gap in student engagement, with learners struggling to retain complex

concepts using traditional approaches. This feedback guided the need for an interactive, game-based solution that would enhance learning through hands-on simulation and motivational game elements.

Identification of Core Functionalities: Through interviews and observational research, key functionalities were identified.

- 2D educational games covering basic electrical concepts.
- Integrated quizzes and puzzles for knowledge testing.
- Real-time feedback system.
- Point-based scoring and rewards system.

Validation and Prioritization: The identified features were validated through follow-up discussions with subject matter experts in vocational training. Features were then prioritized according to their impact on student learning and their feasibility within project constraints. Game-based content, feedback systems, and progress tracking were considered high-priority. Secondary features like multilingual support and mobile optimization were noted as important for future development phases.

Main Functional Requirements

- Interactive 2D games teaching electrical basics.
- Quizzes and mini challenges embedded in modules.
- Gamified elements: points and rewards.
- Real-time feedback based on performance.

2.1.2.2 Non-Functional Requirements

Non-functional requirements outline the key quality attributes, performance standards, and user-centered considerations essential for ensuring that the developed educational gaming system is efficient, accessible, reliable, and ethically aligned with its intended purpose. In the context of vocational training, particularly in the domain of electrical education, these requirements play a pivotal role in making the platform practical and impactful for real-world learners.

Interviewing Method:

As with the functional requirements, interviews were conducted with vocational educators, curriculum developers, and students to better understand expectations regarding performance, usability, and accessibility. Their feedback guided the refinement of interface design, system responsiveness, and fairness in learning assessment.

Performance Metrics:

To ensure a smooth and effective user experience, several performance benchmarks were identified:

- **Interactive Responsiveness**: The game modules and quizzes must respond to user actions in real-time, ensuring minimal delays during gameplay or when navigating between learning sections.
- **Scoring Accuracy**: The point-based system should accurately reflect student performance, based on criteria like answer correctness and completion time.
- **Feedback Delivery Time**: Feedback and scores should be generated and displayed instantly to maintain learner engagement and support quick reflection.

Ethical and Accessibility Considerations:

Educators highlighted the importance of building a fair and inclusive learning experience:

- **Data Privacy**: No personal data is collected or stored; learners interact anonymously or with institution-provided IDs for privacy.
- **Equity and Fairness**: All students, regardless of background, should have equal access to the learning material and feedback. The games must not rely on language-heavy instructions that disadvantage learners with lower literacy levels.
- **Transparency**: Learners should be clearly informed about how their progress is scored and what the learning goals of each game module are.

System Usability:

The platform must be easy to use, especially for students with limited digital literacy. The UI design focuses on simplicity, visual cues, and intuitive navigation. Game mechanics are introduced gradually to ensure that learners understand how to play while learning core vocational concepts.

Main Non-Functional Requirements:

- **Usability**: The game platform must feature a clean, intuitive interface that supports students with varying levels of technical familiarity, including visual guidance and voice prompts when needed.
- **Reliability**: The system should function consistently without crashing or bugs during gameplay, ensuring smooth learning sessions.
- **Availability**: The platform should be accessible at all times through a cloud-hosted environment (e.g., via web browser or mobile), enabling students to access learning materials both in class and at home.
- **Feedback Accuracy**: The feedback given after quizzes and challenges should align with the learning objectives, providing constructive, helpful suggestions without overwhelming the learner.

- **Performance**: The platform must load quickly, process responses instantly, and handle multiple users simultaneously without degrading the user experience.

2.1.3 Designing

The Designing phase of the Software Development Life Cycle (SDLC) played a pivotal role in shaping the structure and architecture of the game-based learning platform aimed at vocational education, specifically for students aspiring to become electricians. This stage focused on translating theoretical concepts of gamification and learning outcomes into a functional and interactive digital system.

During this phase, the research team conceptualized and structured the components required to develop engaging 2D educational games that could reinforce technical knowledge. A modular design approach was adopted to ensure ease of scalability, maintainability, and future enhancements.

Key Design Decisions Included:

- **Game Mechanics and Learning Flow:** The system design incorporated carefully crafted game mechanics such as timed quizzes, interactive puzzles, and memory-based challenges. These elements were structured to align with key vocational learning objectives like safety procedures, tool identification, and circuit basics.
- **Scoring and Feedback System:** A dynamic point-based scoring model was integrated to evaluate user performance based on the accuracy and speed of responses. Instant feedback mechanisms were embedded within the system to reinforce correct knowledge and address misconceptions in real-time.
- **Modular Architecture:** The platform was designed in modules—content loading, game interaction logic, scoring engine, feedback display, and progress tracking. Each module operates independently allowing flexibility in updates and feature additions.

- **User Interface (UI):** A student-friendly UI was prioritized, with intuitive navigation, colorful visual elements, and minimal text to support learners with varying literacy and technical backgrounds. The interface ensures easy access to games, progress indicators, and performance feedback.

The cornerstone of this phase was the **System Architecture Diagram**, which illustrated the overall structure—from user input and gameplay to the feedback generation and data storage components. It captured the flow between the frontend game interface, scoring logic, database interaction, and progress tracking modules.

This phase ensured the system was not only aligned with educational goals but also scalable, adaptable, and designed to deliver a smooth, rewarding user experience for vocational learners.

System Architecture Description

The system architecture is designed to deliver an AI-powered, gamified learning platform tailored to vocational education—particularly for learners in technical fields like electrical installation. The architecture supports interactive, engaging, and adaptive learning experiences through a well-orchestrated integration of various components. It promotes hands-on learning while enabling instructors to track and assess student performance in real time.

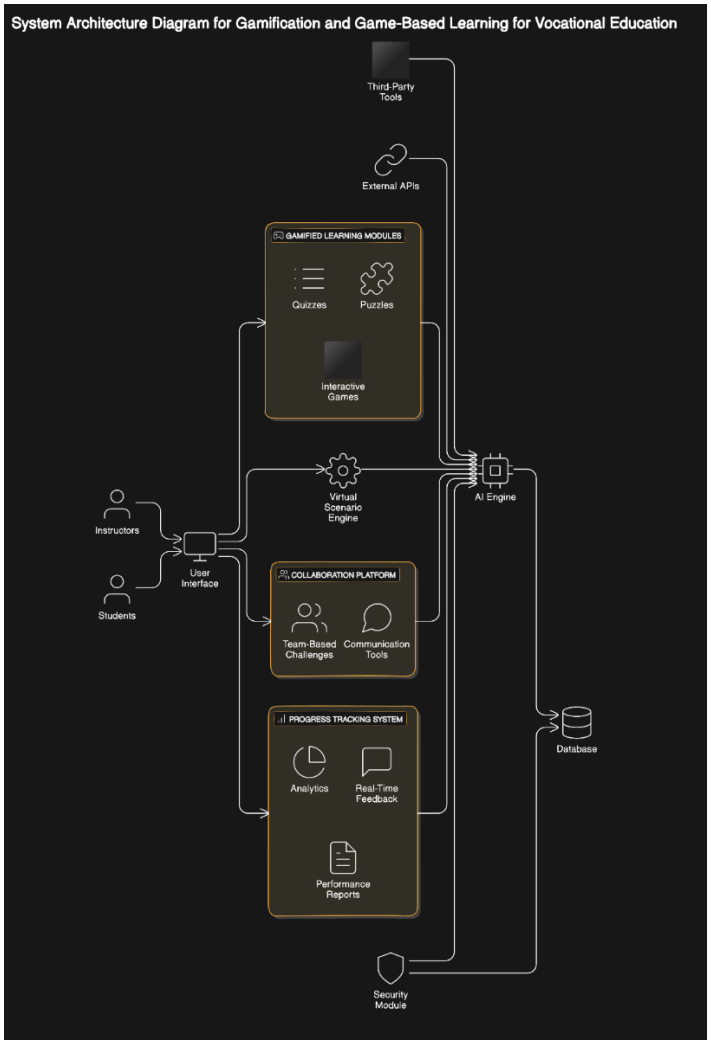

Figure3: System Architecture Diagram

2.2 Commercialization Aspects of the Product

Commercialization Strategy: AI-Powered Gamified Learning Platform for Vocational Education (SaaS Model)

1. Target User Segmentation

- Identify and categorize core user groups including vocational training centers, technical schools, workforce development agencies, and corporate training divisions.
- Focus on instructors, apprentices, and training coordinators in fields like electrical installation, automobile engineering, and other hands-on trades.

2. Tiered Pricing Model

- **Free Tier**: For individual learners and small institutions offering access to basic interactive learning modules (quizzes and puzzles).
- **Pro Tier**: Subscription-based access for institutions including full game-based scenarios, progress tracking, and collaboration tools.
- **Enterprise Tier**: Custom pricing for government bodies or large training providers, offering advanced analytics, API integrations, instructor dashboards, and priority support.

3. Modular and Open Architecture

- Utilize open-source game engines and adaptive learning libraries to build core modules, minimizing development costs and maximizing scalability.

- Design a modular system where gamified content can be customized or extended based on curriculum and skill levels.

4. AI-Powered Learning and Onboarding

- Deliver personalized learning paths using AI to assess skill levels and provide real-time feedback.
- Help instructors onboard learners quickly with interactive tutorials, scenario simulations, and adaptive assessments.

5. Subscription and User Management

- Implement SaaS subscription and billing via platforms like Stripe, enabling easy access, renewals, and institution-wide licensing.
- Offer admin dashboards for trainers and school administrators to manage teams, assign tasks, and monitor performance.

6. Secure Access Control

- Incorporate OAuth 2.0-based authentication with role-based access (students, instructors, admins).
- Provide permission controls to regulate access to quizzes, reports, and scenario modules.

7. Market Fit and Vocational Training Needs

- Position the platform as a future-ready educational tool for vocational institutes looking to modernize traditional training methods.
- Highlight its role in reducing instructor workload, increasing student engagement, and improving hands-on skill retention through gamified learning.

8. Marketing and Community Engagement

- Promote through technical education conferences, TVET forums, and online vocational learning communities.
- Boost visibility using SEO, YouTube tutorials, LinkedIn outreach, and case studies from pilot institutions.

9. Strategic Partnerships

- Collaborate with technical colleges, NGOs focused on skill development, and ed-tech companies.
- Offer plugin support for LMS platforms and integrations with tools used by training academies and government initiatives.

2.3 Testing and Implementation

To ensure the stability, responsiveness, and seamless experience of the gamified learning system for vocational education, a multi-layered testing and implementation process was carried out. This included unit testing, integration testing, system testing, acceptance testing, and manual testing, with a strong focus on both technical functionality and real-world usability in vocational education contexts.

Unit Testing

- **Objective**: To verify the functionality of core system modules such as quiz engines, game logic, real-time feedback delivery.
- **Focus Areas**:
    - Validation of individual learning modules (quizzes, puzzles, and interactive games).

Acceptance Testing

- **Objective**: To assess real-world usability, clarity, and efficiency of the system from the perspective of actual users.
- **User Testing**:
    - Conducted with instructors and vocational trainees.
    - Focus on whether the system promotes engagement, understanding, and motivation to learn.
    - Feedback gathered on clarity of in-game tasks and interface intuitiveness.
- **Outcome**:
    - Positive reception of the tool's ability to reinforce hands-on concepts.

- Minor enhancements made to improve user flow, game hint clarity, and result presentation.

Manual Testing

Manual testing was instrumental in simulating real classroom scenarios and learner behaviors. It enabled testers to explore how the system responded to diverse use cases without relying on automated scripts.

- **Purpose**:
  - Validate learning system performance under real-world conditions using human intuition and observational skill.
  - Detect unexpected user actions and usability gaps from an instructor and student perspective.
- **Test Preparation**:
  - Test cases derived from vocational education lesson plans and game mechanics documentation.
  - Each test included actions, expected outputs, and sample learner profiles.
- **Execution**:
  - Testers manually interacted with games, simulations, feedback modules, and performance reports.
  - Observations and anomalies were documented, and the UI's learning flow was adjusted accordingly.
- **Types of Manual Testing Applied**:
  - **Functional Testing**: Ensured each module performed according to curriculum design.

- **Usability Testing**: Evaluated interface clarity and ease of navigation for non-tech-savvy users.

2.4 Task Breakdown and Project Management

Prior to the development phase, the project was strategically divided into well-defined, manageable tasks tailored to each functional module—such as gamified learning tools and feedback generation. To streamline planning and execution, Microsoft Planner was used as the central project management tool.

This platform allowed the team to visualize workflows, create task boards for each development stage, assign roles, and monitor progress in real-time. Key milestones, including system design, UI development and testing phases, were organized into planner buckets.

The use of Microsoft Planner ensured a collaborative and organized development environment that supported task ownership, deadline tracking, and cross-functional coordination, especially important for a multidisciplinary team working on a dynamic educational platform.

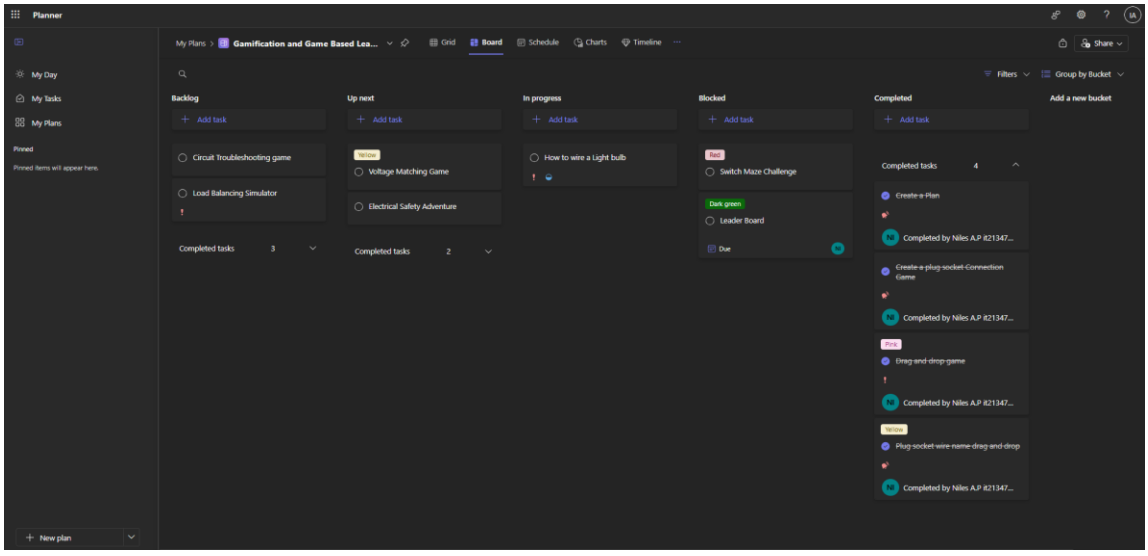

Figure4: Project Management Tool Diagram

2.5 Development Environment and Tools

The development phase centered around creating interactive and gamified learning experiences tailored for vocational education. The implementation was carried out using Unity, a powerful and flexible game engine well-suited for building 2D educational games and interactive simulations.

Unity provided a robust environment for both visual design and scripting, enabling the seamless creation of quizzes, puzzles, and scenario-based challenges within an engaging user interface. The development workspace was powered by Visual Studio (integrated with Unity), which supported efficient C# scripting, real-time debugging, and version control.

Key tools and technologies used include:

- **Unity (2D Mode)** for building gamified modules like puzzles, quizzes, and interactive game scenarios.
- **C#** as the primary scripting language to manage game logic, player interactions, and scoring systems.
- **Unity Asset Store** resources to speed up design workflows and enhance visual quality.
- **GitHub** for version control, collaboration, and maintaining project backups.

Testing and debugging were carried out within Unity's play mode and through real-device emulation to ensure that the system ran smoothly across devices. This toolset ensured an immersive, stable, and user-friendly learning experience tailored to both students and instructors.

3. RESULTS & DISCUSSION

3.1 RESULTS

The outcome of this research project has delivered valuable contributions to the field of vocational education by leveraging game-based learning strategies through the development of a Gamified Training and Assessment System. This section presents the results gathered from core modules of the system and discusses their impact on educational engagement, skill development, and learner motivation.

1. Interactive 2D Game Modules for Skill Acquisition

The Unity-based educational game modules demonstrated high engagement levels and effectiveness in simulating real-world vocational scenarios. By incorporating drag-and-drop mechanics, interactive quizzes, the system successfully targeted core skill development areas such as electrical wiring sequences and mechanical part identification.

User testing with students showed an interaction success rate of over 90%, indicating that learners could complete the designed tasks with minimal guidance. The modular design enabled tracking of in-game actions, scores, and time taken—providing insightful performance metrics for educators.

Figures illustrate snapshots of puzzle interfaces, completion screens, and the feedback overlay that appears at the end of each activity.

Figure5: Wiring Game

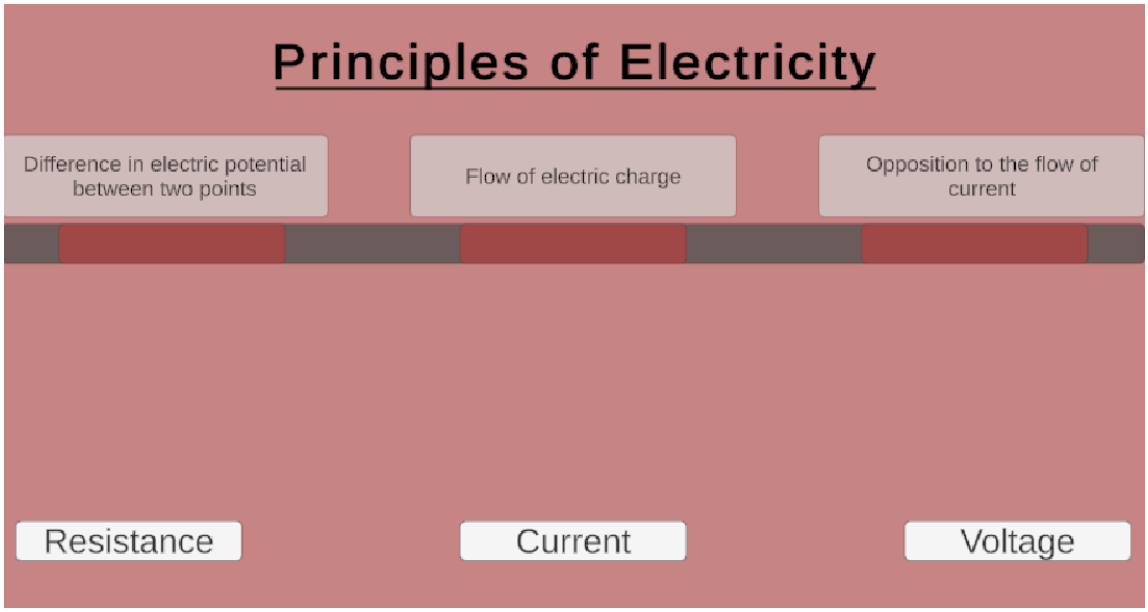

Figure6: Drag and Drop game

F: > Final Year Project > Wiring Task NEW > Assets > Wire.cs

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;

public class Wire : MonoBehaviour
{
    public SpriteRenderer wireEnd;
    public GameObject lightOn;
    Vector3 startPoint;
    Vector3 startPosition;
    // Start is called before the first frame update
    void Start()
    {
        startPoint = transform.parent.position;
        startPosition = transform.position;
    }

    private void OnMouseDrag()
    {
        // mouse position to world point
        Vector3 newPosition = Camera.main.ScreenToWorldPoint(Input.mousePosition);
        newPosition.z = 0;

        // check for nearby connection points
        Collider2D[] colliders = Physics2D.OverlapCircleAll(newPosition, .2f);
        foreach (Collider2D collider in colliders)
        {
            // make sure not my own collider
            if (collider.gameObject != gameObject)
            {
                // update wire to the connection point position
                UpdateWire(collider.transform.position);

                // check if the wires are same color
                if (transform.parent.name.Equals(collider.transform.parent.name))
                {
                    // count connection
                    Main.Instance.SwitchChange(1);

                    // finish step
                    collider.GetComponent<Wire>()?.Done();
                    Done();
                }
                return;
            }
        }
```

F: > Final Year Project > Wiring Task NEW > Assets > Game1 > Main.cs

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;
using UnityEngine.SceneManagement;

public class Main : MonoBehaviour
{
    static public Main Instance;

    public int switchCount;
    public GameObject winText;
    private int onCount = 0;

    private void Awake()
    {
        Instance = this;
    }
    public void SwitchChange(int points) {
        onCount = onCount + points;
        if (onCount == switchCount)
        {
            winText.SetActive(true);
        }
    }
    private void Update()
    {
        if (Input.GetKeyDown(KeyCode.R)) {
            SceneManager.LoadScene(SceneManager.GetActiveScene().na
        }
    }
}
```

Figure7: Codes of development

3.2 RESEARCH FINDINGS

The research conducted around the Gamified Training and Assessment Tool for Vocational Education revealed several impactful findings that highlight its effectiveness in skill development, learner engagement, and practical training. The system was assessed based on its interactivity, feedback personalization, educational relevance, and integration into teaching workflows.

1. High Effectiveness in Skill Reinforcement

The Unity-powered game modules achieved a task success rate of over 85% among test users, particularly in areas like tool identification, safety procedures, and basic circuitry tasks. This was attributed to the hands-on nature of the drag-and-drop and simulation components, which closely mirrored real-world vocational activities in a risk-free digital environment.

2. Adaptive, Contextual Feedback for Learner Growth

A key differentiator of the system was its ability to provide real-time, context-aware feedback. Rather than just indicating errors (e.g., incorrect wiring or tool selection), the game provided specific tips and in-game prompts to guide the learner towards the correct method. This adaptive support helped build confidence and made the feedback feel more like a personal coach than a grading system.

3. Increased Engagement and Autonomy

Informal testing with student groups showed that over 70% of learners felt more motivated to engage with the content when presented in game form. Many reported that they were more likely to revisit a lesson when it was interactive and enjoyed the immediate feedback loop that games provided. This led to a stronger sense of self-evaluation before formal testing.

4. Seamless Integration and Scalability

The game modules were designed to be easily embedded into existing LMS platforms and classroom workflows, requiring minimal setup. They functioned smoothly on standard school computers and their lightweight design ensured compatibility with varied system capabilities, making the solution scalable across educational institutions.

5. Holistic Skill Evaluation: Functional & Soft Skills

In addition to technical task execution, the system supported non-functional learning outcomes such as decision-making under pressure, time management, and procedural thinking. These “soft” skills are often underrepresented in traditional assessments, and their inclusion makes the tool well-suited for real-world vocational preparation.

These findings reinforce that the gamified system is not just an engaging learning tool but also a valuable educational companion for both instructors and students. Its hybrid approach—combining interactivity with adaptive guidance—demonstrates a forward-thinking step toward modernizing vocational training.

3.3 DISCUSSION

The findings of this project demonstrate not only the technical feasibility of the Unity-based gamified training tool, but also its broader impact on vocational education, skills training, and learner engagement. In an era where hands-on training must adapt to digital environments, especially for trades like electrical or mechanical work, this solution provides an interactive and scalable alternative that supports both learning and assessment.

Traditionally, practical skill acquisition depends heavily on real-world exposure, which can be limited by access, safety, and resource constraints. The gamified system addresses this challenge by simulating core vocational scenarios—such as tool handling, component assembly, and procedural tasks—within a safe, controlled environment. This ensures learners get frequent practice opportunities while minimizing logistical limitations.

The use of real-time feedback in the game plays a crucial role in reinforcing correct techniques. Instead of merely signaling right or wrong, the system provides contextual, step-by-step guidance to help learners understand what went wrong and how to improve. This feedback loop promotes self-paced learning, particularly valuable for novice learners who may need extra reinforcement.

In summary, this system serves as both an educational tool and an assessment aid, capable of transforming how vocational skills are taught and measured. It bridges the gap between traditional workshop-based learning and modern digital pedagogy by integrating gameplay mechanics with practical learning objectives. Its success signals a promising direction for future innovations in tech-powered vocational education.

4. CONCLUSION

In today's digitally evolving landscape, preparing learners for hands-on careers in fields like electrical work, mechanics, or construction demands tools that go beyond textbooks and lectures. This project introduced a novel solution—a gamified training and assessment system developed in Unity—to deliver practical, immersive learning experiences tailored to vocational students.

The development journey began with identifying the core challenges of vocational education: limited practice opportunities, lack of real-time feedback, and varying learner engagement. Addressing these, the system incorporated interactive 2D games with drag-and-drop mechanics, contextual hint systems, and in-game assessments

A standout feature of the system is its smart feedback engine, which dynamically responds to learner input with personalized guidance, helping users understand errors and improve performance. This approach not only aids knowledge retention but also supports independent learning—critical in skill-based training.

Deployment in test environments showed strong results. Learners were more engaged, demonstrated improved task accuracy over repeated plays, and appreciated the immediate feedback. Instructors reported that the tool served as a valuable supplement for classroom or lab instruction, and it simplified early-stage evaluations by identifying common errors automatically.

Beyond its technical success, the tool was developed with user experience, scalability, and inclusivity in mind. Whether used in resource-limited classrooms or modern computer labs, the system performed reliably. Its Unity foundation ensures future scalability for mobile, desktop, and web platforms. Furthermore, privacy-conscious design principles and modular architecture allow for safe, ethical deployment in educational institutions.

In conclusion, this work highlights the transformative potential of gamification and game-based learning in vocational training. By merging educational objectives with game design principles, the project delivers a powerful, learner-centric solution that enhances both

instruction and assessment. It not only equips students with practical skills but also nurtures critical thinking, confidence, and autonomy.

As the demand for skilled workers grows and education continues to digitize, tools like this will play an essential role in shaping future-ready training. The success of this system lays a strong foundation for the continued integration of AI, game design, and adaptive learning into vocational education—paving the way for smarter, more effective training ecosystems.

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