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INNOVATION IN ACTION: TURNING IDEAS INTO REALITY



INNOVATION IN ACTION: TURNING IDEAS INTO REALITY

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FOREWORD

Innovation is the driving force behind progress. It begins with a simple idea, often sparked by a question, a challenge, or a dream, and transforms into a solution that can shape lives, industries, and societies. *Innovation in Action: Turning Ideas into Reality* is a celebration of such transformation. This book is a compilation of selected innovation projects from the 2025 Inventopia FBM-Seremban International Innovation Competition (FBM-SIIC), an online platform organised by the Faculty of Business and Management, Universiti Teknologi MARA, Seremban Campus. The competition brought together brilliant minds from students, researchers, and professionals, showcasing a wide collection of creative solutions, prototypes, and conceptual breakthroughs.

Each entry featured in this book represents more than just a product or idea; it embodies critical thinking, collaboration, perseverance, and a genuine desire to address real-world problems. From sustainable technology and digital tools to community-based initiatives and educational solutions, the innovations presented here span diverse fields and reflect the interdisciplinary nature of 21st-century problem-solving.

Our aim in compiling this book is not only to highlight the ingenuity of the participants but also to inspire others to believe in the power of ideas and act on them. Whether you are seeking inspiration, partnership, or simply a glimpse into the future of innovation, this collection offers valuable insights and possibilities. Let these pages ignite your imagination, and may your next idea become tomorrow's reality.

Editor

Chapter 1

Developing the Interface and Functionality of Gamified Quiz Platform

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ABSTRACT

In recent years, digital learning tools have become essential in education. Static quiz platforms are utilized due to its ease of use, automated grading, and structured assessments. However, this platform often lacks interactivity and engagement, leading to passive learning experiences where students simply complete quizzes. In contrast, gamified quiz platforms introduce elements such as real-time feedback, leaderboards, points, and time-based challenges, making learning more engaging. The project aims to analyze and compare the features of gamified and static quiz platforms, providing insights for educators on how to optimize digital assessment tools for better teaching and learning outcomes. Using a non-experimental approach, data was collected through observation and document analysis. The features of static platform were described and compared with gamification elements, focusing on the interface and functionality of those platforms. Based on the developed gamified quiz platform, the findings revealed several key differences in their design, functionality, and user engagement potential. Future research should examine how long-term use of gamified platforms affects student motivation and retention compared to static platforms. Conducting longitudinal studies could provide deeper insights into the sustained impact of gamification on learning outcomes.

Key Words: Gamification, static platform, interface, interactivity, functionality.

1. INTRODUCTION

In education, digital learning tools play a crucial role in assessments and student engagement. While static quiz platforms offer structured assessments with automated grading, they often lack interactive features, resulting in passive learning experiences. In contrast, gamified platforms integrate real-time feedback, leaderboards, time-based challenges, and many more features fostering greater engagement. This study aims to analyze and compare the features of both gamified and static quiz platforms to provide educators with strategic insights into optimizing digital assessment tools. The goal is to enhance both teaching effectiveness and

learning outcomes through a detailed understanding of how interactive features can influence student engagement and motivation.

2. LITERATURE REVIEW

Static quiz platforms have been extensively utilized due to their straightforward design and capability to administer and grade assessments efficiently. Literature indicates that while these platforms ensure a high degree of control over the assessment process, they may not encourage significant student interaction or engagement (Smith & Doe, 2019). Studies have shown that the lack of interactive elements can lead to rote learning, where students focus more on scoring rather than understanding the material (Johnson, 2020).

Gamification in educational settings incorporates game design elements into non-game contexts, aiming to boost student engagement and motivation (Lee & Hammer, 2011). Elements such as points, badges, and leaderboards are used to transform the learning environment, making it more stimulating and enjoyable (Kapp, 2012). Research by Gomez et al. (2015) suggests that gamified learning tools can enhance student participation and motivation, potentially leading to higher retention rates and better comprehension of the content.

3. METHODOLOGY

This study employs a non-experimental, comparative analysis to examine the differences between static and gamified quiz platforms in educational settings. The methodology is designed to provide insights into interface and functions of each platform.

3.1. Observation

Observations were conducted to capture the interface of both static and gamified quiz platforms. Observational data helped in understanding the practical use in different settings.

3.2. Comparative Analysis

The features of each platform were systematically compared based on usability, design, interactivity, and educational impact.

3.3. Development of a Gamified Quiz Platform

A gamified quiz platform was developed specifically for this study to ensure controlled comparisons. Key gamification elements integrated include real-time feedback, leaderboards, point systems, and time-based challenges.

4. RESULTS & DISCUSSION

The comparative analysis between static and gamified quiz platforms revealed distinct differences in their design and functionality, particularly highlighting the more traditional features of static platforms. The findings indicate that static quiz platforms typically exhibit the

fixed layout, simple navigation, sequential progression, absence of game elements, and structured assessments. Figure 1 illustrates the example of static quiz platform.

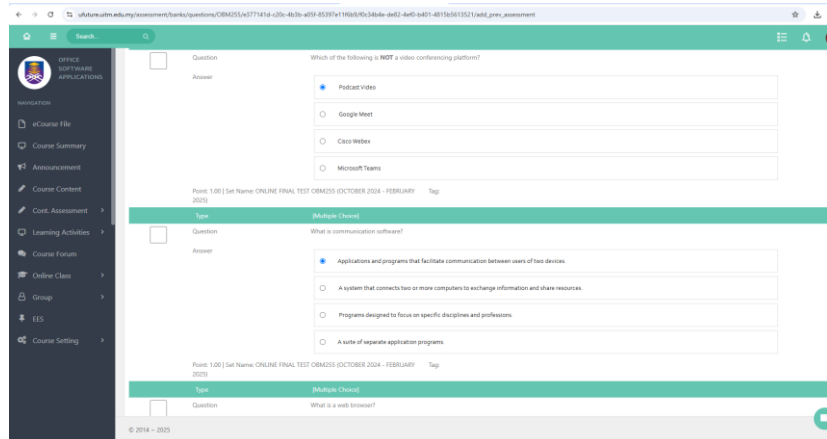
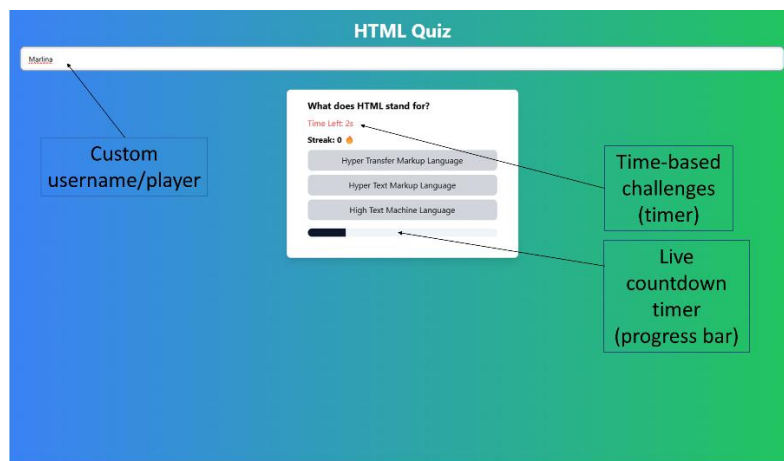


Figure 1: Example of Static Quiz Platform

The developed gamified quiz platform in Figure 2 demonstrated that it is significantly enriched with various gamification elements, which could possibly contribute to a dynamic and engaging user experience.



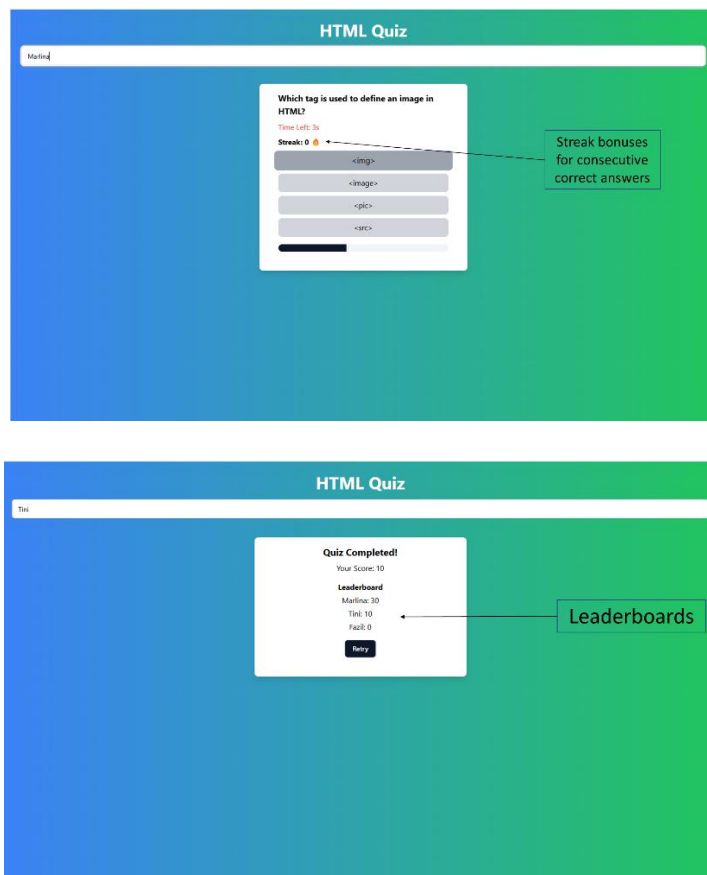


Figure 2: Example of Developed Quiz Platform Based on Gamification

5. CONCLUSION

In conclusion, this study highlights the key differences between quiz platforms with gamification elements and static platforms, focusing on their features, functionalities, and possible impact on user engagement. The findings demonstrate that gamified platforms offer enhanced interactivity through gamification elements, possibly fostering greater student engagement compared to the more structured, passive nature of static quiz tools.

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Chapter 2

GUI-Based Health Simulation Tool for Predicting Pandemic Spread Using the SEIR Model

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ABSTRACT

This project presents a user-friendly Graphical User Interface (GUI) simulation tool designed to support healthcare professionals and researchers in visualizing and predicting the spread of infectious diseases using the SEIR (Susceptible-Exposed-Infectious-Recovered) model. The tool incorporates a Multistep Block Method, a numerical technique that improves computational efficiency compared to traditional Runge-Kutta methods. By allowing users to input disease parameters such as infection rate, incubation period, and recovery rate, the tool dynamically generates graphs and numerical outputs that illustrate the potential trajectory of an outbreak. This innovation addresses the need for accessible, real-time decision support in public health, enabling users to model intervention strategies like quarantine, vaccination, or social distancing, and assess their projected impact. Unlike many modelling tools that require technical expertise, this GUI simplifies complex epidemiological concepts, making it suitable for medical personnel, public health officials, and students in health-related fields. Its intuitive design and low system requirements allow easy deployment on standard computers, making it ideal for use in clinics, universities, and resource-constrained settings. With further adaptation, the tool can be extended to simulate other communicable diseases, offering valuable insights for outbreak preparedness, training, and policy development.

Key Words: SEIR model, pandemic simulation, healthcare forecasting, medical decision support, GUI tool.

1. INTRODUCTION

Recently, the world has been alarmed by a new, fast-spreading variant of the coronavirus originating in Wuhan, China, known as SARS-CoV-2, which affects the respiratory system

and other organs in the body (Jain, 2020). This disease, named COVID-19, has impacted not only thousands of individuals who have fallen ill or succumbed to the virus but has also disrupted daily life, businesses, global trade, and movement, all of which have significantly affected the global economy (Haleem et al., 2020). During this crisis, government decisions and interventions are essential to mitigate the virus's spread and estimate the number of susceptible, exposed, infected, and recovered individuals. These estimates support policymakers in making critical decisions on vaccination strategies, movement restrictions, social distancing, and other preventive actions. It is crucial that these estimates are generated rapidly to facilitate timely responses during this health crisis.

The SEIR model is a mathematical framework that simulates pandemic spread by categorizing individuals into four groups: those at risk of infection (susceptible), those who are infected but not yet contagious (exposed), those who can transmit the disease (infected), and those who have recovered. This model differs from the traditional SIR model by incorporating an incubation, or "exposed" period, representing the 2-3 days before an individual becomes infectious to others after contracting COVID-19.

Previously, researchers have explored various methods for solving the SEIR model. Rustan and Handayani (2020) applied the Euler method to a modified SEIR model for COVID-19 in Indonesia, while Aakash et al. (2023) used both the Euler and fourth-order Runge-Kutta methods to address the model's complexity. Recently, Palma et al. (2024) demonstrated that simulations using fourth- and fifth-order Runge-Kutta methods produced patterns consistent with MATLAB's ODE45 algorithm. Mungkasi (2021) introduced a multistage method, utilizing successive approximation and variational iteration methods to derive semi-analytical solutions for the SEIR model. The Mickens method, a non-standard finite difference approach, has also been applied, preserving the SEIR model's dynamic properties while simplifying implementation.

The SEIR pandemic model is a type of Ordinary Differential Equation (ODE), and selecting efficient numerical algorithms for solving these equations is crucial for reducing computational times. Recent research has focused on developing cost-effective computational methods, underscoring the importance of computational efficiency for solving ODEs (Cockayne et al., 2019). For instance, the Modified Euler method has shown considerable efficiency gains in simulating moderately stiff chemical kinetics in reactive-flow models on GPUs, outperforming traditional methods (Niemeyer et al., 2014). This highlights the impact of method selection on computational performance, particularly when handling large systems of independent ODEs.

In this paper, we present a multistep block approach that uses a block strategy to estimate two approximate solutions simultaneously and a multistep technique to reduce the number of function calls in the algorithm. Together, these two features decrease the algorithm's computational time, making it particularly effective for models with numerous variables and parameters involving large populations. The accuracy of this approach is further enhanced through a predictor-corrector strategy, where the algorithm first predicts approximate solutions using a lower-order method, then corrects them using a higher-order method to improve precision.

Building on this new approach for solving the SEIR model, our next objective is to develop a Graphical User Interface (GUI) based on the proposed multistep block method to simulate pandemic spread. Such a GUI will be especially useful for policymakers, researchers, and health professionals who may lack expertise in mathematical modelling or

programming (Mohd Jamil et al., 2022). This user-friendly interface will assist in forecasting disease transmission dynamics, providing essential data-driven recommendations to inform government policies and preventive measures across economic, social, and educational domains.

2. METHODOLOGY: GUI PROGRAM

Next, we will implement our multistep block method in the GUI program created by using C programming with GTK widget toolkit under macOS operating system. A GUI is a type of computer human interface on a computer, where people and computers communicate with each other (Jansen, 1998). A GUI allows users to interact with software by handling events like mouse clicks, selections, and text input. It responds to these inputs by updating the visible elements (widgets) on the screen (Banerjee et al., 2013). This user-friendly interface benefits users from various backgrounds who may not be familiar with mathematics or programming. By simply inputting parameter values, users can view visual and numerical data of the spread simulation, helping them analyse and recommend suitable intervention solutions.

The GUI program involve the process of developing and running a simulation for the SEIR (Susceptible-Exposed-Infectious-Recovered) model using a C programming interface with GTK widgets. The process begins with designing a user-friendly interface, where users can input various parameters, total population, and step sizes, essential for configuring the simulation. These inputs are then processed through a multistep block method algorithm to solve the SEIR model equations, which simulate the spread of a disease over time. The simulation generates both graphical projections of pandemic trends and numerical values for each population category (S, E, I, R). The simulation continues iteratively, allowing users to analyse changes until they choose to end it. This process provides insights into how different parameters affect pandemic dynamics.

3. RESULTS AND DISCUSSION

After entering the input parameters, users can monitor the model's behaviour. By pressing the 'Run SEIR Model' button, a projection graph (as shown in Figure 1) and numerical values (as shown in Table 1) for the S, E, I, and R groups will be displayed.

The Figure 1 shows the dynamics of the SEIR (Susceptible-Exposed-Infected-Recovered) model over a period of 20 days. Initially, the Susceptible population (purple line) starts high and steadily decreases as individuals move into the Exposed (blue line) and subsequently the Infected (green line) categories. The Exposed group rises gradually as more susceptible individuals are exposed to the infection, eventually levelling off as these individuals transition to the Infected category. The Infected population grows as exposed individuals become actively infectious, peaking and eventually declining as they recover. The Recovered population (orange line) increases as infected individuals recover, reflecting the cumulative number of recoveries over time.

Similarly, Table 1 illustrates the dynamics of disease spread in the SEIR model in terms of numerical values. The susceptible population declines as individuals transition through the exposed and infected phases, with a corresponding rise in the recovered category. This pattern is typical of infectious disease progression, where susceptible individuals are gradually replaced by exposed, infected, and eventually recovered individuals over time.

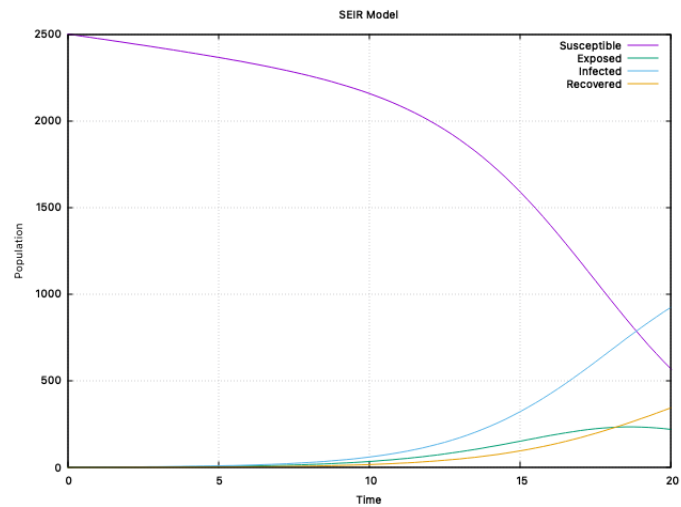


Figure 1: The projection graph of SEIR individuals.

Table 1: The numerical values of SEIR individuals.

t	S approximate	E approximate	I approximate	R approximate
0	2500	1	1	0
2	2448.29599	1.658886	2.624919	0.415349
4	2394.13718	3.61357	5.900195	1.306114
6	2333.79245	7.819432	13.004974	3.254551
8	2259.55187	16.559746	28.155796	7.451931
10	2156.62101	33.985648	59.585725	16.290092
12	1999.53412	66.311176	122.028125	34.269446
14	1753.76283	118.717339	237.33836	68.864603
16	1397.00463	184.13965	425.261704	129.680506
18	965.570782	230.138906	675.578949	223.048155
20	566.538128	219.047677	924.053643	343.778783

Given that a new method is being introduced, it is important to compare its performance with previously established methods to assess and analyse its effectiveness. For this purpose, comparisons will be conducted with the Runge-Kutta order 4 (RK4) method.

Table 3: The comparison of computational time

	RK4	Multistep
Total function calls	1280	652
Total step of iterations	80	42
Time taken (seconds)	0.000202	0.000190

4. CONCLUSION

The SEIR model effectively captures disease progression dynamics, showing a decline in the susceptible population as individuals transition through exposure, infection, and recovery stages. When compared with RK4, the proposed multistep method improves computational efficiency by reducing iteration steps and function calls, offering a faster alternative ideal for large-scale simulations, thus supporting cost-effective and timely analysis in fields requiring extensive computational resources.

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Chapter 3

S_N2 5E Model 2.0

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ABSTRACT

Based on reflections from past lessons, the *Fantastic Excel* group found that students had difficulties in writing the S_N2 (bimolecular nucleophilic substitution) mechanism learned in organic chemistry because it is difficult to visualise the processes that occur at the molecular level in three dimensions. Students also experienced difficulty in comparing the reactivity towards S_N2 reactions among various classes of haloalkanes. To address this learning problem, a lesson study was conducted on 21 students in the F3T3 practicum. Two cycles were carried out to improve the related teaching and learning activities and materials, resulting in the production of the S_N2 5E Model 2.0, which is a digital tool containing links to various activities such as animated videos, online "hands-on" simulations and interactive digital gameshow-oriented exercises. S_N2 5E Model 2.0 assists students in learning the S_N2 mechanism based on the 5E Model, which includes 5 phases of learning, namely Engage, Explore, Explain, Elaborate and Evaluate. S_N2 5E Model 2.0 also enables students to carry out self-directed learning and can be utilised as a teaching aid by lecturers in tutorial classes. Through S_N2 5E Model 2.0, students can actively involve themselves in activities that explore, construct and deepen the understanding of the S_N2 mechanism at a submicroscopic level and subsequently strengthen the mastery of the symbolic domain in writing the mechanism using correct arrows and molecular structural formulas. The learning strategy used in this innovation is in line with 21st-century learning and is suitable for future education. This innovation project has been successfully disseminated at the college level and subsequently to other colleges.

Key Words: S_N2 5E Model 2.0, S_N2 mechanism, 5E Model

1. INTRODUCTION

To prepare students to meet the demands of the future, learning methods must change from conventional methods that often emphasise memorisation practices to methods that can equip students with critical thinking skills, problem-solving skills and exploratory learning skills. Therefore, the *Fantastic Excel* innovation project has used a learning approach based on the 5E Model (Bybee et al., 2006) which includes 5 phases of learning (Engage, Explore, Explain, Elaborate and Evaluate) as described in Table 1.

Table 1. Description of the 5E Model Phase Functions

Phase	Description
<i>Engage</i>	Stimulates students' interest and curiosity by linking the teaching and learning topic with past learning experiences.
<i>Explore</i>	Allows students to interact with the concepts being learned through hands-on activities to generate new knowledge and skills.
<i>Explain</i>	Provides opportunities for students to explain a concept according to their understanding and enables lecturers to provide further explanation to guide students to deepen their understanding of the concept.
<i>Elaborate</i>	Enables students to apply what they have learned to a new situation to enhance their understanding of the concept.
<i>Evaluate</i>	Encourages students to conduct self-assessment of their understanding of concepts and mastery of specific skills, while lecturers can assess students' progress in achieving learning objectives.

2. ISSUE AND PROBLEM STATEMENT

According to Johnstone (2006), abstract concepts in chemistry require thinking at three levels, namely macroscopic (things that can be seen with the naked eye), submicroscopic (things that cannot be seen with the naked eye such as atoms, molecules and ions) and symbolic (the use of symbols, formulas and chemical equations). Abstract concepts in organic chemistry also encompass these three levels or domains (Dwyer & Childs, 2017). Among these abstract concepts is the organic reaction mechanism. The organic reaction mechanism is a detailed account of electron movement during the breaking and forming of bonds that occur in a reaction (Wade & Simek, 2017). The writing of reaction mechanisms involves the symbolic domain. Students need to use appropriate chemical symbols and structural formulas to represent the reagents and organic molecules that react, in addition to using arrows to represent the movement of electrons. The submicroscopic domain includes the depiction of covalent bond formation involving the attack by an electron-rich species, i.e. a nucleophile, on an electron-deficient species. The macroscopic domain is largely learned in practical classes through observations made when organic compounds react with reagents. However, most organic reactions are not learned in practical classes. Therefore, students' understanding of these reactions depends solely on learning that involves the symbolic and submicroscopic domains.

Based on reflections from past teaching and learning, we found that students experienced learning difficulties for the S_N2 (bimolecular nucleophilic substitution) mechanism in Topic 7: Haloalkanes. The S_N2 mechanism is difficult for students to understand even though it only involves one step because students need to visualise in three dimensions the process of nucleophilic attack on the haloalkane, the formation of the transition state and the configuration of the final product. It was found that 45% of students were unable to compare the reactivity of haloalkanes from various classes towards S_N2 . Results from random interviews with students showed that students tend to memorise the S_N2 mechanism which is considered different from other topics because it has a rate-determining step and a transition state. 30% of students were not proficient in using arrows to show nucleophilic attack on the haloalkane molecule while 20% were unable to draw the transition state and the inverted configuration of the resulting molecular structure. These errors are similar to the common errors listed in the *Laporan Kerja Calon* (Matriculation Division, 2023) for the achievement of

Kolej Matrikulasi Negeri Sembilan (KMNS) students in the Matriculation Programme Semester Examination (PSPM) Chemistry 2 SK025 in the 2022/2023 session.

3. OBJECTIVES

The objectives of the innovation were set as follows:

1. 100% of students can write the S_N2 mechanism correctly for the reaction of haloalkanes with ^-OH and ^-OR ions.
2. 100% of students can compare the reactivity of different classes of haloalkanes towards S_N2 .

4. SOLUTION STRATEGY, INNOVATION AND NOVELTY

The *Fantastic Excel* group produced an innovation project called S_N2 5E Model 2.0 to actively involve students in activities that explore, construct and deepen the concepts of the S_N2 mechanism at a submicroscopic level and subsequently strengthen the mastery of the symbolic domain in writing the mechanism using correct arrows and molecular structural formulas. Two cycles were carried out in a lesson study (Figure 1) involving the Focus, Improve and Share procedure (Ministry of Education Malaysia, 2019) to produce the S_N2 5E Model 2.0.



Figure 1. Lesson Study Cycle



Figure 2. SN₂ 5E Model 2.0

SN₂ 5E Model 2.0 is a digital learning tool that contains links to various teaching and learning materials and activities for learning the SN₂ mechanism (refer to Figure 2). The sequence of content in SN₂ 5E Model 2.0 is based on the 5E Model, starting with an animated video introducing the SN₂ mechanism and followed by a role-play video, an SN₂ explanation video using ball and stick models, online hands-on simulations and finally, interactive exercises that assess students' level of mastery. The interactive exercises were developed using the Wordwall application and are gameshow-oriented, providing feedback to students immediately after they answer a question. The SN₂ 5E Model 2.0 innovation has been registered for copyright under the Intellectual Property Corporation of Malaysia with registration number LY2024M03160.

5. TARGET GROUP

Our target group consisted of 21 KMNS students (10 male and 11 female) from the F3T3 Physical Science Stream Practicum for the 2023/2024 session.

6. DATA COLLECTION AND DATA ANALYSIS

A questionnaire containing five items involving the Likert Scale (1-5) and one open-ended question was used to collect student feedback after the intervention in Cycle 1. Data analysis showed that three items obtained a mean score of 5.00 and two items scored 4.95 (refer to

Table 2). This indicates that students gave very positive feedback on the activities and digital application (S_N2 5E Model) used in learning the S_N2 mechanism.

Table 2. Analysis of Feedback on S_N2 Mechanism Teaching and Learning

Questionnaire Item	Mean	S. D.
The activities carried out are suitable for achieving the learning outcomes.	5.00	0.00
The activities carried out enhance my knowledge and understanding of S _N 2.	4.95	0.22
The activities carried out increase my interest in learning the S _N 2 mechanism.	5.00	0.00
The activities carried out are interactive and enjoyable.	4.95	0.22
The digital application used is suitable for training me to write the S _N 2 mechanism.	5.00	0.00
Overall	4.95	0.12

Pre-test and Post-test 1 were conducted to assess students' mastery of the S_N2 mechanism before and after the intervention. The Pre-test and Post-test 1 consisted of one structured question and five objective questions with a total score of 10, to be answered within 20 minutes. After the intervention, students' achievement with a pre-test mean score of 5.24 and standard deviation of 2.59, which is a Moderate level, increased to a Post-test 1 mean score of 8.52 and standard deviation of 1.63, which is an Excellent level. The learning objectives were achieved, i.e. the percentage of students who successfully wrote the S_N2 reaction mechanism correctly and compared the reactivity of different classes of haloalkanes towards S_N2 increased from 85.7% (28.6% Moderate level, 38.1% Good level and 19.0% Excellent level) to 100% (23.8% Good level and 76.2% Excellent level).

7. INNOVATION IMPROVEMENT

The improvement in student achievement in the Post-test after the intervention proves that the activities and materials developed based on the 5E Model are effective in enhancing students' mastery of the S_N2 mechanism. However, several suggestions for improvement from group members and expert reviewers were taken into account to refine the S_N2 5E Model, resulting in the S_N2 5E Model 2.0. Among the improvements made to the innovation were providing clearer instructions for the activities, updating the content of the linked videos, and modifying the gameshow format in the Wordwall application so that marks were awarded based only on correct student answers and not the time taken to answer.

8. REFLECTION ON THE SUBSEQUENT CYCLE AND IMPROVEMENTS

Subsequently, Cycle 2 of the lesson study was conducted on F3T3 students using S_N2 5E Model 2.0. Table 3 shows that both Post-tests 1 and 2 achieved a 100% passing rate. However, the students' mean score for Post-test 2 in Cycle 2 (mean = 8.86, s.d = 1.31) was better than the mean score for Post-test 1 in Cycle 1 (mean = 8.52, s.d = 1.63). This indicates that S_N2 5E Model 2.0 used in Cycle 2 is more effective in achieving the set learning objectives.

Table 3. Comparison of Pre-Test and Post-Test Scores for Cycles 1 and 2

Achievement Level	Marks	Percentage (%)		
		Pre-test	Post-test 1	Post-test 2
Fail	0 - 2	14.3	0.0	0.0
Moderate	3 - 4	28.6	0.0	0.0
Good	5 - 7	38.1	23.8	14.3
Excellent	8 - 10	19.0	76.2	85.7
Mean		5.24	8.52	8.86
(Standard Deviation)		(2.59)	(1.63)	(1.31)

9. CONCLUSION AND DISSEMINATION

S_N2 5E Model 2.0 is more user-friendly and can be used by students for self-directed learning, as well as being utilised by lecturers according to their respective creativity both inside and outside the classroom. Students' mastery of the submicroscopic domain facilitates their acquisition of the skill to write S_N2 mechanisms involving the symbolic domain. The learning strategy used in this innovation is aligned with 21st-century learning. S_N2 5E Model 2.0 also received endorsement from the Head of the Centre for Chemical and Environmental Studies, Universiti Teknologi Mara Negeri Sembilan Branch, Prof Madya Ts ChM Dr Sheikh Ahmad Izaddin Sheikh Mohd Ghazali, who stated that this innovation is suitable for use in enhancing the understanding of school, matriculation and university students in grasping the basic concepts of the S_N2 mechanism. Following this, S_N2 5E Model 2.0 was disseminated at the college level and subsequently to other colleges.

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Chapter 4

GeoStride: GPS-Integrated Safety Boots

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ABSTRACT

GPS-integrated safety boots from GeoStride effectively address the critical workplace safety gap by combining real-time location tracking with advanced protective footwear. Aiming primarily at the construction, mining, and manufacturing industries, these boots contain an SOS button and a GPS module, enabling instant emergency response. One of the product's significant innovations is using eco-friendly materials, consisting of microfiber leather, ergonomic insoles, and lightweight composite toe caps, providing comfort, durability, and sustainability. The survey findings from 42 respondents show that GeoStride features were strong points, with almost 82% admitting a need for real-time tracking and 73.8% pointing out the SOS button. Despite battery life, durability, and the privacy issues mentioned, the unique functionality and design details of GeoStride certainly enable it to be regarded as a trendsetter in the field of security innovation. Features include mobile app integration, pro-aesthetics, and several customization options, making the product even more appealing. GeoStride is the emblem of the future of the equipment that provides personal protection by assuring worker safety, elevating productivity, and upholding sustainable practices. This cutting-edge product, propelling us into a new era of occupational safety, will, however, be in a class of its own by being up to date with the recent advances in technology and the environment.

Key Words: GPS-integrated safety boots; real-time location tracking; emergency response; eco-friendly materials.

1. INTRODUCTION

The deficiency of proper safety measures exposes workers in the construction sector to higher risks around larger and hazardous worksites (Rahman et al., 2022). If the former type of safety boots can physically protect employees, they are without the possibility of their location being traced quickly. This may be a reason for the delay of rescue operations, worsening conditions for severe injury or death (Ochoa-De-Eribe-Landaberea et al., 2024). Therefore, approaches

for developing solutions such as GPS-integrated work boots can be an option to solve this problem.

GPS-integrated safety gear offers real-time location tracking to organize workplace/blog emergency handling better. This is done by integrating a GPS module in the boots and crafting a mobile app to manage the user's location. During the process, construction workers will collect data to understand the purpose of ensuring they are provided with safety equipment (Arabshahi et al., 2021).

GPS use in safety footwear has a variety of advantages, among others. It promotes safety by providing immediate access to the location, which benefits workers in remote or risky jobs. Moreover, it can enhance productivity as supervisors will be monitoring the position of their workers. Apart from that, the step-counting feature sets a health consciousness among the workers. Nevertheless, implementing GPS-based integrated safety boots carries challenges. The battery lifeline, stability of the GPS module under challenging conditions, and educational aspects concerning users are some of these, which should be overcome by knowing the benefits and proper usage of the product. Fighting such difficulties will stand for the creation of a favorable environment, which is necessary for the popularization and development of this technology among different populations of people (Arabshahi et al., 2021; Ibrahim et al., 2023; Ochoa-de-Erbe-Landaberea et al., 2024).

However, the invention ideas in this field do not stop at the barriers. Future versions of safety boots could include advanced health monitoring features and artificial intelligence to predict potential hazards. Overall, integrating GPS technology into safety boots represents a significant advancement in personal protective equipment, enhancing workers' safety, efficiency, and convenience.

2. PRODUCT OVERVIEW

GeoStride safety boots, incorporating a GPS tracking feature, are the ultimate tools in enhancing safety protocols, which is the most acute requirement for the personnel amidst hazardous vocations. Although traditional safety boots block industrial hazards, the lack of real-time tracking and the communication of emergencies is not their strongest point. GPS technology in boots makes safety a constitutional right with a touch of modern technology, so the environment is much safer and productive. Such an idea is more applicable to industries such as construction and mining, where workers are exposed to dangerous risk areas and work in remote locations (Milner, 2016). Workers' geolocalization will offer timely assistance by emergency services, which undeniably will enhance job safety and decrease the wait time for rescue, which is vital for keeping victims and employees safe.

GPS-integrated boots have become a modern product development trend: product amendments, product lines, repositioning, and pricing mechanisms. Manufacturers can win by using top-notch technology and its integration into standard-issue safety gear, knowing the market needs and supplying complete safety solutions. GeoStride boots have the safety features of providing comfort and endurance, as well as protecting the environment. The boots are created of lightweight, eco-friendly, and ergonomic materials, thus minimizing fatigue, improving comfort, and featuring a fashionable design. These boots also feature sophisticated communication and security because of GPS tracking, an SOS button, and integration with the mobile app. To stress this point further, the GeoStride boots, equipped with GPS technology, bring a revolutionary change in PPE, since they can help with the most common

safety issues workers and businesses face. The summary of this product is shown in Figures 1 and 2.

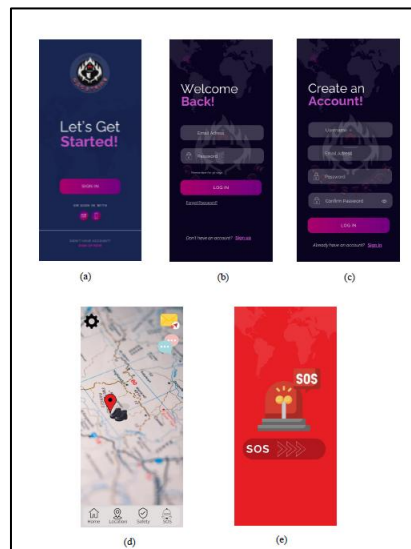


Figure 1. Overview of the safety boot application in the Apple Store (IOS) and the Play Store (Android). (a) Launch screen, (b) Log in page, (c) Sign up page, (d) Home page, (e) SOS Alert Button.



Figure 2. Safety Boots Features

3. METHODOLOGY

The methodology used in developing GeoStride GPS-integrated work boots involved a survey method to assess the feasibility and acceptability of the product. A questionnaire was designed to collect data from construction workers, site supervisors, and safety officers on the importance of safety features, the practicality of GPS inclusion, design issues, and willingness to use the technology. The questionnaire included multiple-choice and scale-type questions to gather responses on issues like problems with current safety equipment, the need for real-time tracking, and potential use cases for GPS-enabled boots. The survey was distributed digitally via email and social media groups related to civil engineering and construction and received 42 responses.

4. RESULTS AND DISCUSSION

The research on safety boots with built-in GPS found several important things. First, most people do not know that these kinds of boots exist. About 83.3% of the people in the survey said they had never heard of safety boots with GPS. This shows a new and unique idea here, and companies can be the first to bring this product to market. It also means more effort is needed to teach people about these boots and their benefits.

The study also asked if people thought GPS tracking in safety gear was needed. About 47.6% said they had been in situations where GPS tracking would have helped. This supports the idea that the boots are helpful. Workers are often in dangerous or far-away places in construction, mining, or oil and gas. Knowing where they are in real time can help save lives in emergencies. Almost half of the people in the study said they had faced such situations, which proves the boots are relevant and needed.

The research also examined how important people think GPS tracking is for workplace safety. Around 45.2% said location tracking is “very important.” This shows that people want this feature and that it meets real safety needs in risky jobs. It also shows that GPS tracking can help keep workers safer by helping supervisors respond faster during emergencies.

Lastly, the study examined the most important features in GPS safety boots. The most wanted feature was real-time location tracking; 81% said it was a must-have. The SOS alert button was also very important, with 73.8% saying it was necessary. These features focus on quick response in emergencies. GeoStride boots, including real-time tracking and an SOS button, match what users want. The research supports that GPS safety boots like GeoStride should be developed and used.

5. CONCLUSION

The journey to create GeoStride boots has been unique. We did market research, created early designs, and tested the product in a small market. The idea first came from comics, where safety problems were solved using new and smart tools. Our surveys showed that people want important features like GPS tracking and an SOS button. We also used eco-friendly materials and ensured the design was comfortable. This matches what today’s customers want. We tested different designs and made changes to ensure the boots work well, are safe, and look good. During our test marketing, many people showed interest in GeoStride. Most said they would buy the boots because the price is fair and the features are new and useful. Some people were worried about battery life, how strong the boots are, and how safe the data is. But these problems can be fixed with better design and clear user instructions. Overall, GeoStride is a product that can do well in the market. More people are looking for smart safety tools, and GeoStride can help protect workers and make their jobs easier and safer.

6. RECOMMENDATIONS

GeoStride GPS-integrated safety boots research and trial findings may support these products' further advancement and market launch. To ensure successful adoption, we have identified several recommendations to enable this transition. These include improving the

product's daily life, increasing the battery life and durability, and developing the design to come up with metal-free materials that can enhance privacy. Moreover, it is crucial to prepare appropriate and straightforward user guidelines, which are, in turn, important in making the product usage effective and trustworthy. A marketing campaign should focus on the advantages that will accrue to the workers using the boots, including enhanced safety and emergency response. Pricing research must be in-depth to align price with affordability. Expansion of the target market beyond construction and mining into emergency services and forestry is also an option to consider. By adopting these suggestions, we believe that GeoStride boots will be considered a revolutionary invention that significantly improves workplace safety and operational efficiency.

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Chapter 5

Influence of Doping Concentration and Thickness of N- and P-Type on the Efficiency Performance of Si Solar Cell Using Simulation Approach

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ABSTRACT

This thesis explores the influence of n- and p-type doping concentrations and thicknesses on silicon solar cell efficiency. To address this, a range of software options for investigating photovoltaic cells, such as the Silvaco tool, Midian, and PC1D software. However, to complete this investigation, PC1D software was chosen. Personal Computer One Dimensional (PC1D) is ideal for any solar cell simulation. The goal of this paper is to examine insights into the numerical modelling of silicon solar cells using the PC1D programme, the design of silicon solar cells with high efficiency by changing ideal features, and the impact of parameters on the IV characteristic of silicon solar cells. Furthermore, the goal of this study is to identify the best efficiency in the design of silicon solar cells by adjusting parameter values such as doping concentration and thickness of n- and p-type value on I-V characteristic. To maximise design efficiency, surface area of 100 cm², a respective doping concentration and thickness with $1 \times 10^{17} \text{ cm}^{-3}$ and 0.05 μm for the n-type, and $1 \times 10^{17} \text{ cm}^{-3}$ and 290 μm for the p-type. The final design's efficiency is 22.58%, and the maximum power output is 2.258 watts.

Key Words: Silicon, Solar Cells, Doping Concentration, Thickness, PC1D.

1. INTRODUCTION

Silicon solar cells are a silicon semiconductor-based photovoltaic (PV) cell. These types of solar cells are commonly used in the market since they are inexpensive and have a lifespan of more than 25 years without requiring extensive maintenance (Bouich, 2023). Crystalline silicon PV cells have a maximum efficiency in converting energy of 25%. However, apart from excellent high efficiency cells capable of efficiencies greater than 20%, regular industrial cells are limited to 15-18% (Saga, 2010). Because of this large increase in efficiency, the power

rating of a common size panel increased from 250 W to more than 420 W. Silicon's band gap is somewhat low enough for an ideal solar cell, and because it is an indirect material, it has a relatively small absorption coefficient.

It is utilised near the front of the cell, where the majority of the light is absorbed because n-type silicon has a greater surface quality as an emitter dopant than p-type silicon. As a result, the negative terminal is at the top and the positive terminal is at the bottom of the cell. Typically choose emitters with a thickness of less than 1 μm because a significant percentage of the light is absorbed on the front surface. By making the front layer extremely thin, a significant fraction of the carriers created by the light that comes in are formed within a diffusion length of the p-n junction. Additionally, the front connection has a doping level at which the generated power can be conducted away without resistive losses. But too much doping lowers the quality of the material to the point where carriers recombine before they reach the junction (Kharchenko, 2019).

The purpose of this study holds immense significance within the realm of solar cell technology. This study was to understand the influence of doping concentration and thickness of n- and p-type layers on the efficiency performance of silicon (Si) solar cells using a simulation-based approach for advancing renewable energy sources. This study aims to quantify the relationship between dopant concentration, layer thickness and the resulting photovoltaic efficiency of Si solar cell. The findings will provide insight into optimizing the design and performance of Si solar cells for enhanced energy conversion in photovoltaic applications. This could lead to the development of more efficient solar cells, thus contributing to the goal of making renewable sources more accessible and economically viable.

2. METHODOLOGY

Table 1 shows the value of parameter that becomes basic parameter to be use in this study. This fundamental parameter has been obtained from (Belarbi et al., 2014). Only a few parameters, such as n-type doping, p-type doping, and thickness on the n- and p-regions will be manipulated in this study.

Table 1 The value of basic parameter for simulation of silicon solar cell

Parameter	Value
Device area	100 cm^2
Exterior front reflectance	10%
Region 1	n-type
Thickness	10 μm
Dielectric constant	11.9
Band gap	1.124 eV
Intrinsic concentration at 300K	$1 \times 10^{10} \text{ cm}^{-3}$
N-type background doping	$1 \times 10^{19} \text{ cm}^{-3}$
Bulk recombination	1000 μs
Region 2	p-type
Thickness	100 μm
Dielectric constant	11.9
Band gap	1.124 eV
Intrinsic concentration at 300K	$1 \times 10^{10} \text{ cm}^{-3}$
N-type background doping	$1 \times 10^{16} \text{ cm}^{-3}$
Bulk recombination	1000 μs
Excitation	One-sun

Source: (Belarbi et al., 2014)

Figure 2 below shows the schematic diagram of light-trapping (LT) schemes with planar surface and a p-n junction. The doping value of n-type and p-type will be varied between 10^{15} cm^{-3} to 10^{22} cm^{-3} . The same procedure was applied with the varies thickness of n- and p-type with the rage of $0.05 \mu\text{m}$ to $0.95 \mu\text{m}$ and $20 \mu\text{m}$ to $290 \mu\text{m}$ respectively. The results for short-circuit current density (I_{sc}), open circuit voltage (V_{oc}) and maximum power output were tabulated.

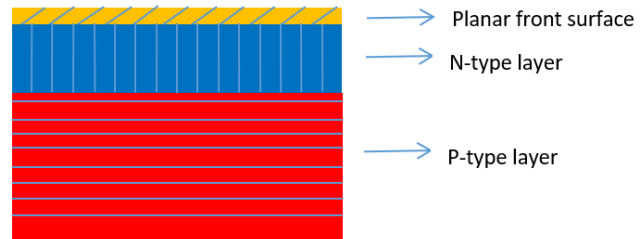


Figure 2 Schematic diagram of light trapping schemes of solar cell

3. RESULT & DISCUSSION

3.1. Influence of doping concentration at n- and p-type region

The value of doping at the n-type was continually altered from 10^{15} cm^{-3} to 10^{22} cm^{-3} . Meanwhile, the doping at the p-type gradually increased from 10^{15} cm^{-3} to 10^{22} cm^{-3} . The findings are presented in Table 2.

Table 2 influence of doping at n- and p-type region

N doping (cm^{-3})	I_{sc} (A)	V_{oc} (V)	P_{max} (W)	FF	η (%)
10^{15}	-3.425	0.7454	2.064	-0.8085	20.64
10^{16}	-3.425	0.7456	2.071	-0.8110	20.71
10^{17}	-3.425	0.7461	2.075	-0.8120	20.75
10^{18}	3.372	0.7290	2.008	-0.8169	20.08
10^{19}	-1.578	0.6547	0.8474	-0.8202	8.47
10^{20}	-0.7784	0.6062	0.3912	-0.8290	3.91
10^{21}	TCF	TCF	TCF	-	-
10^{22}	-2.934	-0.6858	SCF	-	-
P doping (cm^{-3})	I_{sc} (A)	V_{oc} (V)	P_{max} (W)	FF	η (%)
10^{15}	-3.425	0.7454	2.064	-0.8085	20.64
10^{16}	-3.425	0.7478	2.138	0.8348	21.38
10^{17}	-3.423	0.7590	2.225	0.8564	22.25
10^{18}	-3.279	0.7141	1.982	0.8465	19.82
10^{19}	-2.762	0.6800	1.573	0.8375	15.73
10^{20}	-2.558	0.6485	1.384	0.8343	13.84
10^{21}	-2.527	0.6192	1.291	0.8251	12.91
10^{22}	-1.443	0.3918	SCF	-	-

One issue that may occur when applying PC1D simulation is transient convergence failure (TCF) and steady convergence failure (SCF). Several reasons can come into play, such as the normalized error limit being set too low. Doping concentration at 10^{17} cm^{-3} has the maximum efficiency. Additionally, the highly doped emitter is considered a dead layer, occurring between 10^{18} cm^{-3} and 10^{20} cm^{-3} with substantial carrier recombination. High

recombination rates can have an influence on efficiency. The findings are consistent with previous research by Mandong et al.

3.2. Influence of the n- and p-type region thickness

Table 3 demonstrates the impact of thickness at the n-type on I_{sc} , V_{oc} , P_{max} , FF and efficiency. The thickness at the n-type varied from 0.05 μm to 0.95 μm , while the thickness at the p-type ranged from 20.0 μm to 350.0 μm . The thickness of n-type at 0.05 μm has the highest performance (18.85%), while the thickness at 0.95 μm has the lowest (17.19%). While p-type thickness of 290 μm has the highest efficiency (21.62%) and the lowest efficiency (20.0 μm) is 18.85%. The thickness of the emitter and base layer can also significantly affect the fill factor and overall performance of the device. According to Belarbi et al., the n- and p-type is responsible for manufacturing most of the electron, which contribute to the electrical conditions. At the same time, electrons must travel some distance to reach the external circuit through the cathode, and the shorter this distance, the greater the chance that more electrons will exit the cell and contribute to conduction. The thin top layer allows more light energy to reach the depletion region. As base thickness increases, the cell absorbs more photons, which excites more electrons into the conduction band, resulting in a greater I_{sc} . A base thickness of 10 μm results in the lowest cumulative photogeneration. Then it grows slowly as the base thickness increases, eventually reaching its peak at the thickest point. In short, a particular base thickness is necessary to collect enough photons to activate electron-hole pairs. However, a thicker cell results in more resistance and cost. The base thickness should be approximately 100 μm (Xiyang Cai et al., 2018).

Table 3 Influence of thickness in n- and p-type region

N thickness (μm)	I_{sc} (A)	V_{oc} (V)	P_{max} (W)	FF	η (%)
0.05	-2.879	0.7689	1.885	0.8515	18.85
0.25	-2.882	0.7426	1.820	0.8504	18.20
0.45	-2.884	0.7269	1.785	0.8483	17.85
0.65	-2.883	0.7210	1.760	0.8467	17.60
0.85	-2.880	0.7147	1.739	0.8449	17.39
0.95	-2.887	0.7120	1.729	-0.8441	17.29
P thickness (μm)	I_{sc} (A)	V_{oc} (V)	P_{max} (W)	FF	η (%)
20	-2.879	0.7689	1.885	-0.8639	18.85
80	-3.350	0.7501	2.116	-0.8421	21.16
140	-3.474	0.7389	2.142	-0.8345	21.42
200	-3.539	0.7307	2.145	-0.8295	21.45
290	-3.595	0.7212	2.162	-0.8339	21.62
350	-3.618	0.7161	2.162	-0.8345	21.62

4. CONCLUSION

A good efficiency for silicon solar cells can be achieved by referring to the maximum performance from each parameter. In this modest effort, the ideal qualities that need to be set as the basic cell to achieve high efficiency are doping of n and p-type at $1 \times 10^{17} \text{ cm}^{-3}$ each. Whereas the thickness of n and p-type that yield a highest efficiency are at 0.05 μm and 290 μm respectively.

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Chapter 6

Breaking Boundaries: eXploreAR Science Transforms Learning Beyond the Lab

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ABSTRACT

eXploreAR Science is an innovative Augmented Reality (AR)-powered learning tool featuring interactive eXploreAR Science is an innovative Augmented Reality (AR)-powered learning tool featuring augmented pages designed to improve students' understanding of abstract scientific concepts in secondary-level science education. This digital tool addresses limitations in traditional lab-based learning through immersive simulations, 3D animations, and interactive quizzes. A pilot study involving 45 secondary students showed significant improvement in conceptual understanding based on pre- and post-test results, with average scores rising from below 40 to between 85 and 100 marks. This suggests strong potential for scalable implementation in various learning environments, making science education more inclusive, engaging, and effective. Designed to improve students' understanding of abstract scientific concepts in secondary-level science education. This digital tool addresses limitations in traditional lab-based learning through immersive simulations, 3D animations, and interactive quizzes. A pilot study involving 45 secondary students showed significant improvement in conceptual understanding based on pre- and post-test results, with average scores rising from below 40 to between 85 and 100 marks. This suggests strong potential for scalable implementation in various learning environments, making science education more inclusive, engaging, and effective.

Key Words: Augmented Reality, STEM Education, Interactive augmented pages, Linear Motion, Digital Learning

1. INTRODUCTION

Science education often faces challenges when students lack access to laboratory setups and hands-on resources, limiting their ability to visualise and grasp complex scientific principles. When students lack access to laboratory setups, these limitations hinder students'

ability to visualise and understand abstract scientific principles. eXploreAR Science addresses this issue through an innovative digital solution powered by Augmented Reality (AR). This approach transforms science learning into an engaging and accessible experience that enhances comprehension while being cost-effective and scalable across diverse educational settings.

2. LITERATURE REVIEW

The use of Augmented Reality (AR) in STEM education has grown due to its capacity to improve student outcomes. AR enables learners to visualise abstract concepts and interact with virtual elements, bridging the gap between theoretical content and practical understanding. Akçayır and Akçayır (2017) found AR significantly enhances motivation and comprehension in science topics. Bacca et al. (2014) further demonstrated that AR improves learning performance and engagement through immersive learning.

Ibáñez and Delgado-Kloos (2018) noted AR's ability to develop spatial reasoning and conceptual understanding in physics. Integrated with mobile technology, AR aligns with constructivist learning theories, offering hands-on digital experimentation. Radu (2014) emphasised AR's adaptability for inclusive education, supporting diverse learning styles with multimodal content (text, audio, animation). These findings support AR tools like eXploreAR Science in promoting deeper learning and broader accessibility in science education.

3. METHODOLOGY

eXploreAR Science was developed to support core science concepts, integrate multimedia content and 3D simulations to aid understanding across a wide range of scientific topics. AR-enhanced pages were created to overlay animations for accessibility via mobile devices. These pages also include interactive quizzes and simulations to engage students actively.

A pre-test and post-test design was implemented to evaluate the tool's effectiveness. A pilot study was conducted in a school environment, where students interacted with the AR materials and provided feedback for improvement. Development tools included an AR-enabled mobile app, 3D models and animations, interactive assessments, and mobile devices, such as smartphones and tablets.

3.1. DEMOGRAPHIC

The pilot involved 45 polytechnic-level students enrolled in science courses. This demographic was chosen to reflect the educational level most likely to benefit from improved conceptual visualisation.

Students first completed a pre-test to establish baseline knowledge. They then used the eXploreAR Science modules, combining digital AR experiences with traditional lab experiments. This blended model allowed students to connect theory with practice.

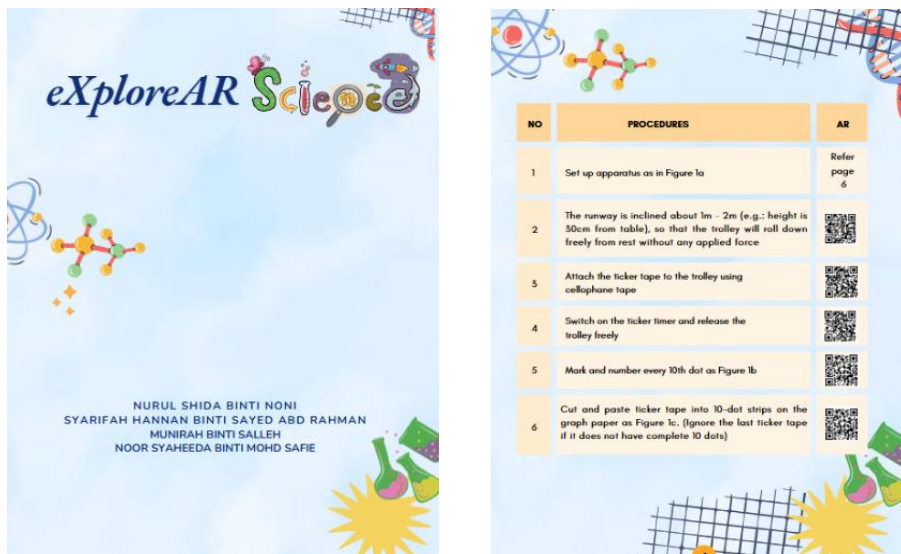


Figure 2: Example of Augmented Pages Used in eXploreAR Science



Figure 2: Students using eXploreAR Science

4. RESULTS

After the learning sessions, students completed a post-test. Comparative analysis showed a marked improvement. Many students initially scored below 40 marks, with some as low as 10 or 20. Post-test results ranged predominantly between 85 and 100 marks.

To quantify this improvement, the average pre-test score across the group was 31.6 with a standard deviation of 9.2, meanwhile, the average post-test score increased to 89.4 with a standard deviation of 6.8. This indicates a mean gain of 57.8 marks, which shows an average percentage improvement of approximately 183%. These statistical results support the effectiveness of eXploreAR Science in significantly enhancing students' academic

achievement in science. Many students initially scored below 40 marks, with some as low as 10 or 20. Post-test results ranged predominantly between 85 and 100 marks.

This significant gain highlights the value of interactive AR content in improving conceptual understanding. The tool helped students internalise abstract physics concepts through visual and immersive elements. Combining AR simulations with hands-on labs addressed various learning preferences, enriching the educational experience.

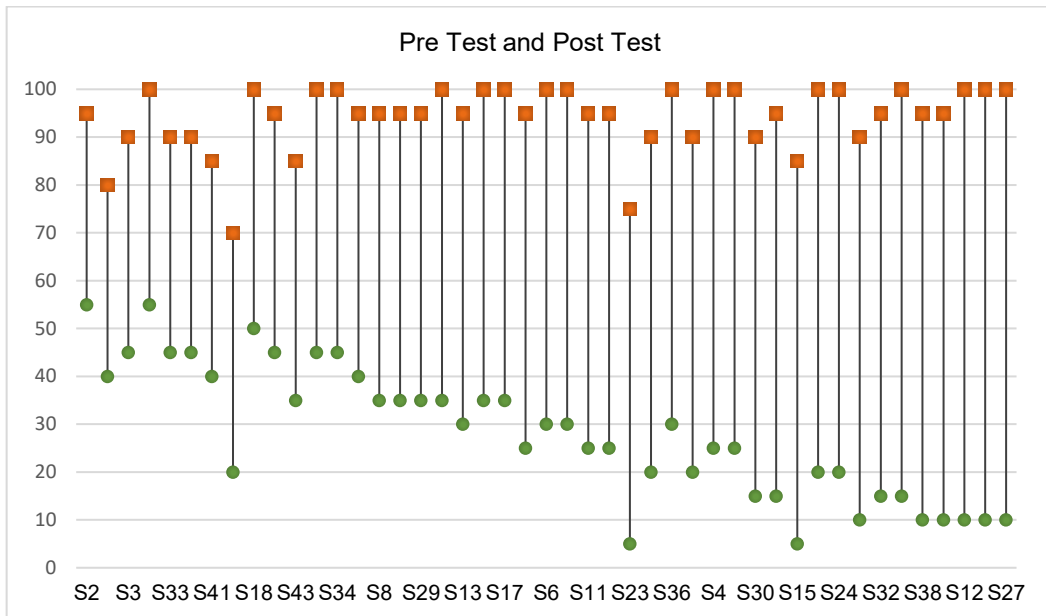


Figure 3: Comparison of Students' Pre-Test and Post-Test Scores

The graph (Figure 3) clearly illustrates consistent score improvements across all students. The green dots represent pre-test scores, while the orange squares represent post-test scores. Every participant showed progress, some by as much as 70 to 80 marks, indicating effective bridging of conceptual gaps.

5. CONCLUSION

eXploreAR Science significantly improved student understanding of science concepts through its AR-enhanced, interactive design. This innovation promotes active learning, better visualisation, and inclusive access to science education, especially where lab resources are scarce.

The pilot study validates eXploreAR Science as a scalable educational tool. Future iterations may expand to additional scientific topics and incorporate real-time feedback for

personalised learning. Further research can explore long-term impacts and broader curriculum integration.

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Chapter 7

DAPoEff: The Ultimate Chemistry Board Game

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ABSTRACT

Understanding chemical equilibrium and Le Chatelier's Principle can be challenging for students due to the abstract nature of these concepts. Conventional teaching methods often fail to engage learners, hindering their ability to achieve desired learning outcomes. To address this challenge, DAPoEff: The Ultimate Chemistry Board Game integrated with custom AI chatbot was developed as an innovative solution. The project adopts the ADDIE Model to ensure a structured development process, incorporating gamification to transform the delivery of chemical concepts into an interactive and effective learning experience. With a sample size of 70, the results indicated a significant improvement in students' understanding and application of chemical equilibrium concepts. The triangulation of data shows students' active participation and positive experience in learning the concept. We aspire for DAPoEff to be adopted by educational institutions worldwide, making an interactive approach to learning chemistry accessible to all.

Key Words: DAPoEff, board game, chatbot, chemical equilibrium, Le Chateliers' principle

1. INTRODUCTION

DAPoEff board game is an educational tool designed to simplify complex concepts such as chemical equilibrium and Le Chatelier's Principle in a fun, engaging, and interactive manner. The name DAPoEff represents key concepts: (D) Disturbance, (A) Action to reduce the effect of the disturbance, (PoE) Position of Equilibrium, and (Eff) Effect on reactants and products as equilibrium is re-established. These principles are seamlessly integrated into the design of the board game to ensure a comprehensive and cohesive learning experience. Through interactive gameplay mechanics, players engage strategically to solve challenges presented on task cards, exploring the effects of disturbances on equilibrium systems. Players are encouraged to apply theoretical knowledge and devise strategies to win the game. Movement cards allow players to collect tokens, while power cards can be used to accelerate task completion or hinder opponents. Adding a dynamic twist, a disturbance occurs at the end of

each round, where all players must exchange their movement cards with the player next to them, mimicking real-life external changes that disrupt chemical equilibrium. This innovative project aims to bridge the gap between theoretical knowledge and experiential learning by reimagining the delivery of chemical concepts through DAPoEff, an interactive chemistry board game.

2. PROBLEM STATEMENT

Understanding chemical equilibrium and Le Chatelier's Principle is challenging for many students due to the abstract nature of these concepts (Riddle et al., 2023). Traditional teaching methods, such as lectures and textbook exercises, often fail to engage students effectively or provide interactive, hands-on learning experiences. As a result, students struggle to predict how a system at equilibrium responds to changes in concentration, temperature, or pressure (Liu et al., 2024). Chemical equilibrium is widely regarded as a difficult concept for students to grasp. Its complexity arises from its abstract nature, the need for mathematical calculations, and the interpretation of graphs to fully comprehend the material (Andriani et al., 2021). According to the Matriculation Examination Report for Chemistry (SK015) for the academic year 2022/23, students often fail to internalize the concept and struggle to apply it when answering questions. Specifically, 35% of candidates were unable to state the effect of temperature on the concentration of HCl in a given chemical equation. Furthermore, 60% of students were unable to predict the position of equilibrium or use the correct terminology to accurately explain the argument for the context of endothermic reaction (BMKPM, 2023). Students find it difficult to visualise equilibrium shifts because lecture notes and textbooks alone do not provide a dynamic representation of the process. Even with the inclusion of technological tools such as PowerPoint slides and videos, the delivery often remains one-directional and does little to enrich students' understanding. This limitation arises from the passive nature of the available teaching resources, which do not encourage active participation or effective engagement with the concept.

3. OBJECTIVES:

- i. To enhance students' understanding of Le Chatelier's Principle via the improvement of test score in answering question related to problem-solving
- ii. To provide engaging and effective learning sessions through the interactive DAPoEff board game.

4. METHODS & MATERIAL

ADDIE Model was adopted to develop the innovation project.

Analysis (A)

In this phase, the focus is on understanding the learning objectives, target audience, and educational challenges. From the survey and worksheet, students struggle with concept of chemical equilibrium and Le Chatelier's principle. Thus, innovation project was aligned to the learning objectives of applying Le Chatelier's Principle to predict shifts in equilibrium in response to changes in several factors like concentration, temperature, and pressure. The

targeted audience is for pre-universities and college-level students studying chemistry. The educational challenges involved the lack of students' active participation in the conventional teaching methods, thus there is a need for interactive learning methods that promotes students' centred learning.

Design (D)

This phase focuses on creating the structure, rules, and components of the game. Players compete to complete the task card based on different equation at equilibrium while navigating the impact of external changes on the system. The game mechanics includes board, movement cards, power cards, and tokens to solve the equilibrium challenges in the task card. This covers the whole complexity of chemical equilibrium from (D)Disturbance, (A) Action to reduce the effect of disturbance, (PoE)Position of Equilibrium and the (Eff) Effect towards reactants and products when the equilibrium is re-established. Thus, the board game of DAPoEff was designed.

Development (D)

The development stage focuses on creating the game materials and testing prototypes. This involves a series of improvement and testing the mechanics for balance and fairness in the game structure. The comprehensive rule book was developed to display the set up instructions, gameplay mechanics, and scoring systems. The game flow was refined based on feedback from alpha and beta-testing which includes both students and teachers' perspective.

Implementation (I)

This phase is where the game is introduced and used in real learning environments. Teachers brief the instruction and provide the demonstration based on the rule book. There are mentors acting as moderators facilitating the game play, clarifying rules and answering related questions on the game structures. The innovators reflect on each implementation session.

Evaluation (E)

The evaluation phase is to assess the effectiveness of the game in meeting learning objectives. A pre-test and post-test were administered to evaluate students' understanding on molecular polarity. Students' feedback was analysed, interviews' transcript and worksheet were examined. Make necessary revisions to enhance the learning experience.

5. FINDINGS

i. Students' understanding

From Figure 1, all the classes selected for intervention showed an improvement in performance by an increase in the overall mean score. For class H37, the mean score improved by 2.50. Meanwhile, the mean score for the class of F17 and H16 improved by 2.34 and 2.47 respectively. The overall mean score for the total respondents of 70 students is 5.58 for pre-test and 8.02 for post-test. This indicates an average improvement of 2.44.

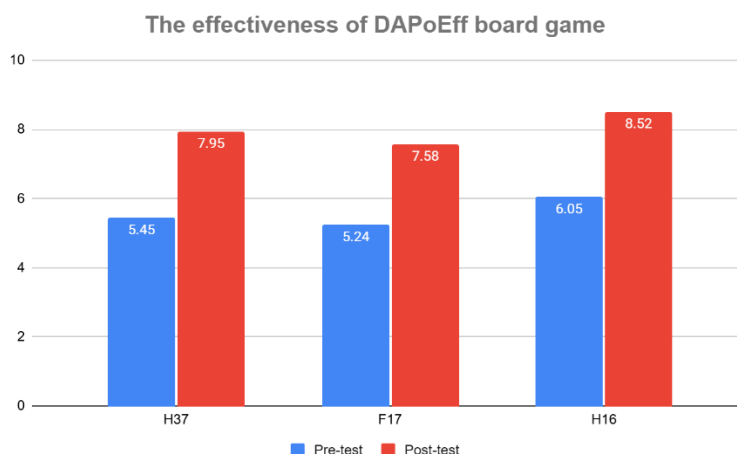


Figure 3: The effectiveness of DAPoEff board game in enhancing students' understanding

ii. Engaging and effective session.

Students' feedback was also taken after the implementation of the DAPoEff board game in the classroom. The following themes emerged from the analysis. In essence, students find that board games effective in enhancing the conceptual understanding. Additionally, they were engaged actively during the session and have a positive experience in learning.

Themes	Description
Effective learning	"Using DAPoEff game help me to understand the Le Chatelier's principle much better." "It is very excellent and well-made game, I hope I can play it again. I think that if I play the game multiple times more, I can understand it better." "The game was fun. I get to understand a bit more about Le Chatelier's Principle especially about the shifting of equilibrium positions."
Active engagement	"I love to have some fun while revising the things that I had learned. Thus, the game really helps me to think the process that happen on paper more realistically". "It's fun to play with friends, learning together about the concept of Le Chatelier's Principle while having fun is the best way to study especially when the topic is confusing." "I am so happy because it makes me want to win the game by recalling all my knowledge about the Le' Chatelier's principle."

6. CONCLUSION

DAPoEff board game has shown to enhance conceptual understanding and create a fun and student-centred learning environment. With a sample size of 70, the results indicated a significant improvement in students' understanding and application of chemical equilibrium concepts. The triangulation of data shows students' active participation and positive experience in learning the concept. We aspire for DAPoEff to be adopted by educational institutions worldwide, making an interactive approach to learning chemistry accessible to all. This is consistent with the fourth aspiration of Sustainable Development Goals (SDG-4) which is to provide quality education.

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Chapter 8

The Grammar Explorer Kids

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ABSTRACT

Language acquisition is a cornerstone of early education, and fostering grammatical proficiency in children requires innovative approaches that blend education with engagement. *The Grammar Explorer Kids* is an educational card game designed to make learning grammar fun, interactive, and accessible for children aged 7 years old and above. However, traditional methods of teaching grammar often struggle to sustain children's interest and engagement. By transforming grammar lessons into an adventurous game experience, *The Grammar Explorer Kids* aims to reinforce language skills while fostering critical thinking and creativity. The benefits of toys like *Pop-Its* that are included in the game may also help to relieve stress and improve focus and fine motor control for young learners.

Keywords: Educational games, grammar learning, interactive learning.

1. INTRODUCTION

Grammar forms the structural backbone of any language yet teaching it to children can be a challenging task. Traditional methods often rely on repetitive exercises and rote memorisation, which can fail to capture the interest of young learners (Ellis, 2013). According to Elina Jaaska and Kirsi Aaltonen (2022), implementing game elements into learning can significantly enhance engagement and retention in the educational context. Despite the increasing popularity of game-based learning (Plass, Homer, and Kinzer, 2015), there remains a gap in grammar-focused resources that are both effective and engaging for primary school children. This aligns with findings by Gee (2003), who argued that well-designed games create meaningful learning experiences by immersing players in problem-solving tasks.

The Grammar Explorer Kids addresses this gap by combining language education with interactive gameplay to create an immersive learning experience. Research has shown that integrating play into learning not only motivates students but also enhances cognitive

development (Vygotsky, 1978). This card game is designed to help children aged 7 years old and above understand and apply grammatical concepts in a fun and supportive environment.

1.1 Project Objective / Purpose

There are several objectives of this project. Firstly, this project is to enhance children's understanding and application of grammatical concepts through interactive and engaging gameplay. The game aims to help children aged 6-12 develop basic grammar skills, such as identifying parts of speech, constructing sentences, and applying grammar rules. Secondly, this project aims to create an enjoyable learning experience for learning grammar, which is often perceived as a challenging subject. Traditional grammar teaching methods often lack excitement and fail to capture young learner's attention. By implying elements of play, The Grammar Explorer Kids makes grammar learning enjoyable and engaging. Thirdly, to promote cognitive skills such as critical thinking, problem-solving, and creativity through gamified learning activities. Lastly, it encourages collaboration and social interaction by providing opportunities for group play. The purpose of creating The Grammar Explorer Kids is to address specific challenges in a traditional way of learning grammar and leverage the benefits of gamification for educational purposes. The game seeks to support educators. This game provides teachers and parents with an effective teaching tool, offers an accessible resource for children who struggle with conventional grammar lessons, ensuring that learning is both effective and inclusive.

1.2 Entrepreneurial Opportunities

This project is targeted specifically for parents and educators who are seeking engaging learning tools for children. It is also suitable for people of all ages or anyone who is looking to improve their basic grammar skills.

2. METHODOLOGY

Table 1: Costing to produce 1 set of The Grammar Explorer Kids

Items	Price
Game cards, note cards and instructions card	Rm 32.00
4 fidget poppers	RM 8.00
1 dice	RM 3.00
Packaging box	RM 19.00
Sticker for packaging box	RM 4.50
Total:	RM 66.50

3. RESULTS AND DISCUSSION

Below are the results from the survey to provide feedback on how to better improve the project.

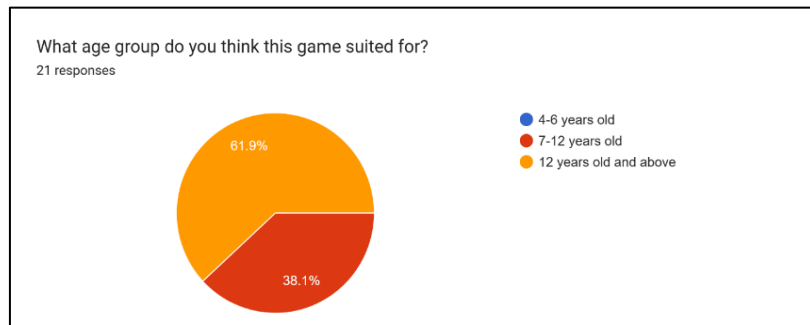


Figure 3.1

Figure 3.1 shows that most participants agreed that the game is appropriate for individuals aged 12 and above. In contrast, only a small portion of respondents expressed the opinion that the game is suitable for children aged 7 to 12 years.

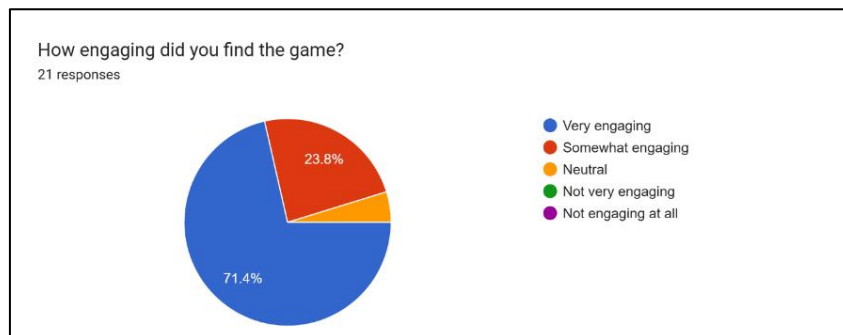


Figure 3.2

Based on the figure above, 15 (71.4%) of the participants found the game very engaging. They highlighted that the ability to play and engage in discussions with their friends during the gameplay significantly contributed to their enjoyment and overall positive experience.

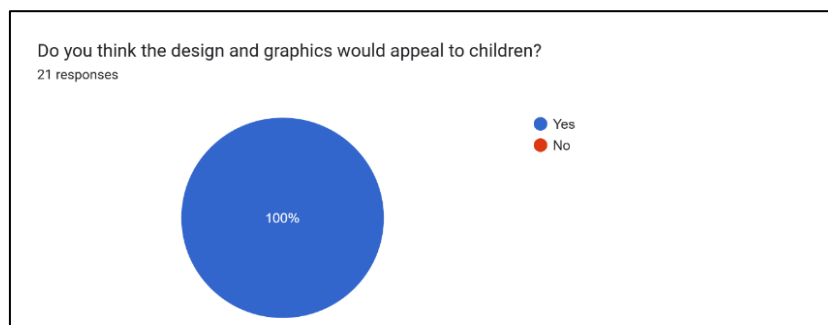


Figure 3.3

All the participants agreed that the design and graphics of the game card are appealing to children. They specifically noted that the use of vibrant colors and images made the game visually attractive and engaging for a younger audience.

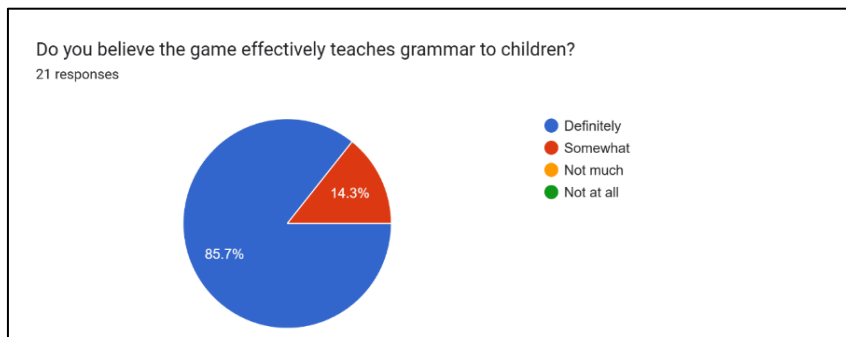


Figure 3.4

Many participants expressed the belief that the game is an effective tool for teaching grammar to children. They noted that playing the game motivated them to improve their grammar skills, as mastering grammar was essential to fully enjoying and winning the game.

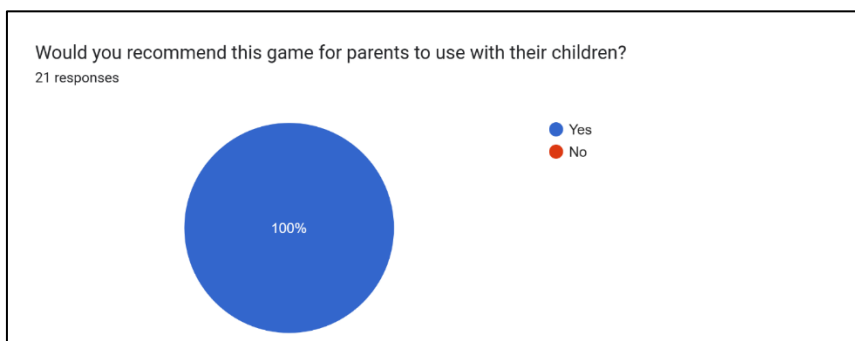


Figure 3.5

According to Figure 3.5, all participants (100%) stated that they would recommend this game for parents to use with their children. The majority highlighted that the game is not only fun and engaging but also provides an educational experience, making it a valuable tool for children's learning and development.

5. CONCLUSION

This project is a medium for many things, making grammar education both accessible and engaging for young learners. By combining fundamental language skills with gamification principles, the game tackles several challenges of learning grammar the traditional way, such as lack of engagement. Beyond its educational value, the game holds vast entrepreneurial potential, for expansion into digital platforms and partnership with schools and educators. Its ability to foster creativity, collaboration, and critical thinking in a playful context ensures its

relevance in modern education. The journey of The Grammar Explorer Kids is not just about learning grammar, but it is about inspiring a love for language through the joy of discovery.

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APPENDIX



Chapter 9

A Virtual Scavenger Hunt to Explore Predictive Reading Skills

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ABSTRACT

Predictive reading skills improve comprehension and analytical thinking; however, many students struggle due to passive learning techniques and limited participation. The lack of creative ideas that incorporate real-world applications further hinders their progress. This initiative tackles the need to modify traditional teaching techniques by implementing AI-powered and technology-driven strategies that encourage active involvement and adhere to sustainable educational principles. This project aims to enhance students' ability to predict textual outcomes using contextual clues, utilizing AI-enhanced features of Google Maps and tools like Microsoft Forms to create an engaging and interactive learning environment. The project's centrepiece is a virtual treasure hunt set in Kota Tinggi, in which students use Google Maps' AI-powered features to navigate between physical locations. At each stop, they answer Microsoft Forms-based predictive reading questions. This paperless strategy not only reduces environmental effect, but it also improves digital literacy and familiarises students with AI-powered tools. The scavenger hunt is carefully structured, with contextual textual clues embedded at each level to direct students to the next site while testing their predicting abilities. This innovation guarantees a seamless, environmentally friendly, and immersive learning experience by leveraging AI in navigation and evaluation technology. Gamifying predictive reading skill development, this project encourages active participation, critical thinking, and collaboration. Students bridge the gap between academic knowledge and real-world applications, gaining practical insights while developing essential 21st-century skills such as digital literacy, teamwork, and problem-solving. This project supports sustainability through a paperless approach, leveraging AI and emerging technologies to improve predictive reading and active learning.

Key Words: Predictive Reading Skills, Sustainable Education, AI-Powered Tools

1. INTRODUCTION

Technology has transformed education by increasing engagement and learning. AI and tools such as Microsoft Forms enable interactive classrooms. According to Pareek (1923), "AI technologies offer engaging interactive learning opportunities that draw in students and encourage participation." This project improves predicted reading progress by combining Google Maps AI with Microsoft Forms interactivity, hence gamifying learning. It promotes critical thinking, teamwork, and sustainability, resulting in a digitally proficient and environmentally conscientious student generation.

2. LITERATURE REVIEW

Developing predictive reading strengthens comprehension and analytical skills. Traditional techniques fall short, whereas AI-driven education increases engagement through dynamic, interactive experiences that actively cultivate higher-order cognitive talents in students. Recent systematic reviews have highlighted the revolutionary power of AI in education. Mustafa et al. (2024) presented a complete systematic review of AI-enhanced educational techniques, claiming that combining AI technologies can result in adaptable and personalised learning environments. Their findings show that technology-driven techniques not only address specific student requirements, but also actively promote critical thinking and predictive skills. The abstract describes an innovation project that uses Google Maps' AI-powered capabilities to create a location-based scavenger hunt, which is consistent with our findings. This immersive method not only promotes active learning, but it also combines physical navigation with cognitive involvement, improving the predictive reading process. Fanning (2024) emphasises that the incorporation of developing technologies in educational situations alters traditional instructional techniques. According to Fanning, AI can revitalize teaching processes by transitioning from static to interactive modes, resulting in increased digital literacy and collaborative learning. In the context of predictive reading, converting a conventional classroom into a virtual exploratory space increases the authenticity of the learning experience. By incorporating textual hints into a practical navigation scenario, the project successfully gamifies the learning process, encouraging students to actively predict and infer outcomes while navigating a variety of physical environments. Research demonstrates that AI-driven evaluation improves educational outcomes. Almalawi, Soh, Li, and Samra (2024) discovered that machine learning outperforms traditional methods for accuracy. Digital technologies such as Microsoft Forms simplify formative assessment by combining evaluation and exploration, increasing pedagogy through data-driven feedback, precision, and active engagement.

3. METHODOLOGY

This innovation project was carried out with the application of a 4-stage theoretical model actions that have been developed by Coughlan and Brannick (2005). Stage 1 (analysis) - we identified that conventional teaching methods, characterized by passive engagement and a lack of real-world context, hamper the development of predictive reading abilities. This deficiency necessitated the incorporation of interactive, technology-driven learning experiences. Stage 2 (planning) - Microsoft Forms are used to ask predictive questions

associated with Google Maps locations, as seen in Figure 1. The scavenger hunt was structured so that each location offered specific textual clues, prompting students to anticipate narrative outcomes and convert context into actionable insights. Figure 1 illustrates the planning phase of an immersive digital scavenger hunt activity.

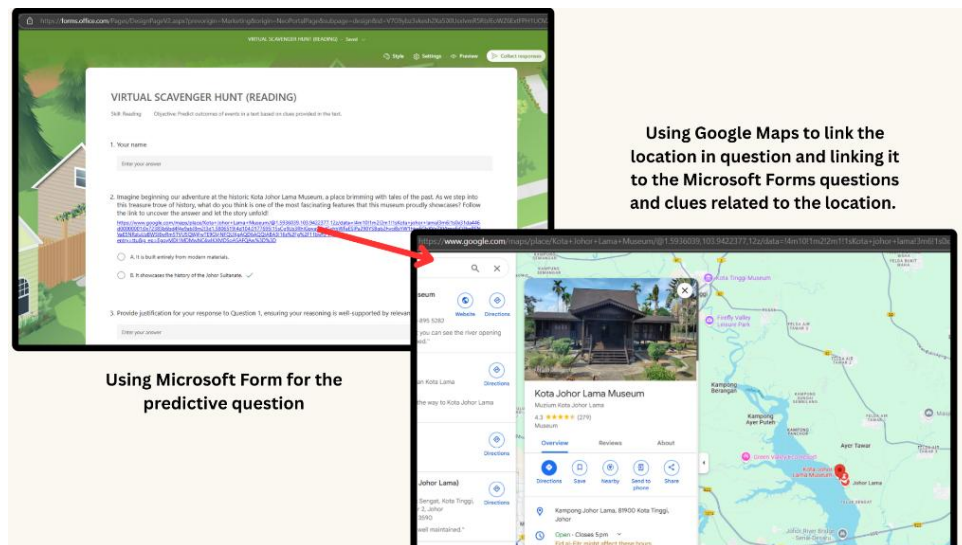


Figure 1: The Immersion Learning Activity's Digital Tool Process Flow

Stage 3 (taking action) - in collaborative groups, students received an initial clue with a digital map link directing them to a starting point in the Kota Tinggi area. Sequential cues guided each group from one checkpoint to another, demanding active problem-solving and predictive analysis. Stage 4 (evaluation action) - this stage involved collecting data from students' responses and reflective feedback. This dual assessment method gauged improvements in digital literacy, analytical thinking, and overall engagement, affirming the effectiveness of our innovative educational approach. This approach exemplifies innovation in active learning.

4. RESULTS & DISCUSSION

The findings of this research are divided into two parts - the virtual scavenger hunt and student reflections regarding the integration of AI and emerging technologies in the activity.

4.1 Analysis on the Students Answers

For question 1 of the first part on demographic profile, 50% of the respondents is male and the other 50% is female. For question 2 (*Imagine beginning our adventure at the historic Kota Johor Lama Museum, a place brimming with tales of the past. As we step into this treasure trove of history, **what do you think is one of the most fascinating features that this museum proudly showcases?***), all the respondents predicted the textual outcome correctly using the contextual clues of the word 'museum' where respondents highlighted the word historical, history and artifacts. They also relied on the reviews left by visitors in Google Maps.

Question 3 - As you explore its exhibits and artifacts, **what fascinating stories and lessons do you think visitors can uncover about this historic site?** Clue: Read Din Saint review at the reviews section in the Google Maps), the clues left by Din Saint's provides the surface of the answers and all the respondents added few additional information that they can get from the internet/background knowledge to justify the answers. All the respondents analysed the map and found the correct answer by referring to the distance and clues (perfect haven) which they associated with peace and natural environment in question 4 - As you explore the rich history of the Kota Johor Lama Museum, now seeking a cozy retreat to unwind nearby. **What charming resort do you think would be the perfect haven, just a stone's throw away from this historic gem?** For question 5 (After a day of exploring the Kota Johor Lama Museum you are seeking for a serene escape. You stumble upon a review by Jessie Wong, sharing her experience at a nearby resort. **What do you think makes this resort so enchanting and appealing to visitors, as described in her story?**), most of the respondents (66.6%) highlighted the Balinese vibes and surrounded by nature (river, wood furniture) to relate with enchanting and appealing to the visitors. Question 6 - Leaving the serene haven of Green Valley Eco Resort, you wander along a peaceful riverbank. **What enchanting destination lies at the end of this dreamy journey, calling you toward its wonder?** - the words like dazzling bugs, magical firefly, firefly-spotting and preserve the nature serenity stated by respondents connected with the soft glow of twilights in the question. 66.6% of the respondents highlighted about the crucial of planning (getting ticket in advance) to ensure smooth experience due to long queue and limited entry slots in question 7 (As you delve into the 'About' section of the park, **what crucial detail do you think travellers should keep in mind to ensure their visit is seamless and unforgettable?**). Finally, more than half of the respondents (66.6%) failed to locate the right answers in question 8 (After marvelling at the magical glow of fireflies at the Firefly Valley Leisure Park, imagine you are yearning to dive deeper into the heart of local culture. **Where do you think your journey would lead them to experience the vibrant traditions and lifestyle of the nearby community?**) as they chose Kampung Panchor- a historical place with historical element (based on google) and not Kampung Berangan since less information is offered on the internet.

4.2 Students' Reflection on the Activity

Question 1 – How did using Google Maps enhance your ability to predict outcomes based on contextual clues in the questions? Provide example of how this tool support your thought process. Based on the responses, majority of the students believed that the integration of Google Maps and Microsoft Forms into the activity improved students' predictive reading skills by using contextual hints, while also generating a lively and interactive learning environment. **Question 2 – In what way did integrating Microsoft Form and Google Maps make the scavenger hunts a more dynamic and engaging learning experience? Reflect on how these technologies influenced your interest and participation.** The virtual scavenger hunt increased student interest and learning by using Google Maps and Microsoft Forms to improve engagement, critical thinking, and technological devices skills. **Question 3 – What specific strategies did you use to make predictions when answering questions during the scavenger hunt? How did the interactive elements help refine these strategies?** The students used logical reasoning, pattern identification, and geographical

evaluation to solve problems. Google Maps significantly improved their approach by delivering immersive, interactive images, encouraging deeper involvement, and effectively refining prediction techniques. **Question 4 – Reflecting on this activity, how do you think the combination of AI (Google Maps) and emerging technologies (Microsoft Forms) supports sustainable and innovative education practices? Share your perspective on how this approach could be applied in other learning contexts.** Student respond emphasises AI's and Microsoft Forms' roles in promoting engaging, long-term learning. This adaptive method improves cooperation, accessibility, and creativity while fostering interactive, future-focused education.

5. CONCLUSION

This innovative project addresses the challenges of teaching predictive reading skills by merging AI and other technologies to promote creativity and sustainability. The virtual scavenger hunt is an exciting, interactive, and environmentally friendly way to teach. This approach not only helps students improve their reading skills, but it also aligns with the wider goal of strengthening sustainable education with modern technology.

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Chapter 10

AR-GREENBUILDING

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ABSTRACT

AR-Greenbuilding was developed as an innovative teaching aid that integrates Augmented Reality (AR) applications into the teaching and learning process for the DCA 2012 Green Building Technology course at Vocational Colleges. The idea for this innovation emerged when students found it difficult to understand theoretical concepts and generate ideas for developing green building model projects based on existing buildings. The objective of AR-Greenbuilding is to enhance student's understanding and visualization of the principles and applications of green technology elements in existing buildings, as well as to help them generate ideas in developing green building models. AR-Greenbuilding was developed using Sketch-Up software to create 3D models. Students are required to scan a poster to view the 3D image and explore the green technology elements in the model. Additionally, students can scan QR codes attach with green technology elements on the poster to display more detailed information via websites. The evaluation phase was conducted to gather feedback, involved 15 students from the Diploma in Construction Technology program. Findings show that respondents provided very positive feedback on this innovation. This innovation not only benefits students and teachers but also reflects a commitment to lifelong learning and environmental sustainability.

Keywords: Augmented Reality, Green Building Technology, Teaching Aid

1. INTRODUCTION

DCA2012 Green Building Technology course is a newly introduced subject under the Diploma in Construction Technology program starting in 2022. This course exposes concepts and applications of green technology in construction, particularly in buildings to students. Throughout observations indicate that students struggle to understand theoretical concepts and develop ideas for their green building model projects based on existing building inspections. This problem is supported by recent studies (Ismail et al., 2019), which found that students face difficulties completing practical assignments due to a lack of visualization skills. As a result, students struggle to apply theoretical knowledge learned in class to complete practical tasks.

The objectives of this innovation are:

1. To help students understand and visualize the principles and applications of green technology elements in buildings.
2. To assist in clearly identifying green technology elements in existing buildings.
3. To help students generate ideas for developing green building models.

2. DESIGN DESCRIPTION

The AR-Greenbuilding innovation was developed as a teaching aid for the Green Building Technology course, intended for use by lecturers and students of the Construction Technology Program at Vocational Colleges. The 3D building design was developed using Sketch-Up software, based on existing buildings, with added elements of green technology.

3. VISUAL

There are four main elements in the AR-Greenbuilding innovation project are the Augmented Reality element, Google Sites, QR Codes, and a Google Form for enrichment sessions. Figure 1 shows the poster highlighting these four features.



Figure 1 Features of the project on poster

Figure 2 shows the flowchart outlining the four main steps for using AR-Greenbuilding.

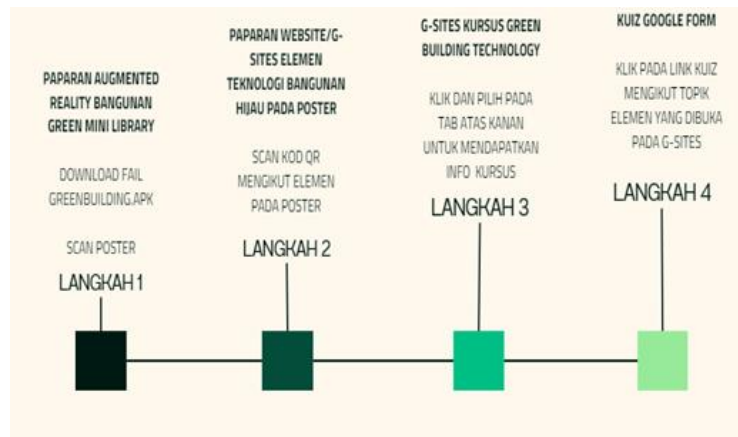


Figure 2 Application Flowchart

Figure 3 shows that students using the AR-Greenbuilding as a teaching aid during lectures and self-learning sessions for the DCA2012 course. The posters were distributed to students during group activities.



Figure 3 Students scanning the QR code on the poster

4. NOVELTY AND UNIQUENESS

The AR-Greenbuilding innovation is fully copyrighted by the Construction Technology Program at KV Port Dickson. The original idea and development of the innovation, including the 3D design, were fully developed by our team based on existing buildings at KV Port Dickson.

5. BENEFITS TO MANKIND

This innovation contributes to improving teaching and learning sessions, particularly for the Construction Technology Program at Vocational College, by enhancing student's understanding of the principles and applications of green technology elements. The AR application helps students visualize and clearly see examples of green technology

elements in buildings. Other than that, AR-Greenbuilding fosters creative thinking in generating ideas for developing green building models and creates a more engaging and interactive teaching and learning environment in line with 21st-century Learning.

6. COMMERCIAL POTENTIAL

The use of the AR-Greenbuilding innovation is not limited to the Construction Technology Program at Vocational College. It is also suitable for courses or subjects related to Green Technology at various educational levels and age groups. Teaching aids based on Augmented Reality are increasingly popular today, as they are more engaging with 3D technology. Aligned with Education 4.0, this innovation holds high commercial value.

7. CONCLUSION

In conclusion, the analysis from the study found that the AR application in the AR-Greenbuilding teaching aid innovation aligns with the stated research objectives. Evaluation results indicate that the development of this innovation helps students increase their motivation to identify green building technology elements and subsequently develop their assignment models. This innovation also enhances their understanding and increase academic performance. The content presented via website helps engage students throughout the teaching and learning process. In the future, this innovation can be improved by diversifying building examples to strengthen student's understanding.

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Chapter 11

JarQuest

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ABSTRACT

Grammar learning is often challenging for primary school students, especially with traditional, repetitive methods that fail to engage diverse learning styles. This paper introduces JarQuest, an interactive, gamified quiz system aimed at enhancing grammar skills in students aged 10 to 12. Featuring an animated jar that fills with points for correct answers, JarQuest motivates learners through visual progress, digital rewards, and level-up incentives. The monthly reset feature supports ongoing assessment and growth. Teacher trainee feedback highlights strong engagement and potential for improved grammar outcomes. JarQuest shows promise as a supportive tool for ESL grammar education in Malaysian primary schools.

KEYWORDS: JarQuest, ESL, interactive quiz-based system, gamification, progress

1. INTRODUCTION

Grammar acquisition is a challenging component for primary school students, particularly when traditional methods relying on repetitive exercises are used. These conventional techniques often fail to engage students meaningfully and may not fully address the diverse learning needs of young learners. As a result, students may struggle to develop a solid understanding of grammar rules, leading to disengagement and frustration. Recognising this gap in the traditional approach, this paper introduces JarQuest, an innovative, interactive quiz-based system specifically designed to strengthen grammar skills among students aged 10 to 12.

JarQuest offers a unique, engaging approach to grammar practice by incorporating game-like elements such as points, levels, and visual feedback. Central to the system is an animated jar that fills with points each time a student answers a quiz question correctly. This visual representation of progress not only makes learning more interactive but also motivates students to stay engaged with the material. Once the jar is filled, students are rewarded with digital incentives, such as level-ups on their profiles, which fosters a sense of achievement

and healthy competition. The jar resets every month, providing an opportunity for both students and teachers to track improvement over time.

The system was developed with the goal of enhancing students' grammar learning experiences by introducing an element of fun, competition, and consistent tracking of progress. Feedback from teacher trainees who trialled the system indicates a positive response to JarQuest's design and its potential for classroom application. This paper will explore the concept of JarQuest, its implementation in the classroom, and its potential to transform grammar learning for primary school students in Malaysia.

2. LITERATURE REVIEW

Traditional grammar teaching for young learners often relies on repetitive memorisation, which may not suit their developmental needs or learning styles. Although interactive methods have been recommended (Farrah & Tushyeh, 2017), they are not widely applied in classrooms. Game-based learning has shown promise in boosting engagement and motivation through elements like points, levels, and feedback. However, if not well-designed, games may distract rather than support learning (Kapp, 2012).

Visual feedback tools like progress bars and point systems also enhance motivation and achievement (Deterding et al., 2011; Hamari et al., 2014), especially when kept simple. Digital tools such as Quizlet and Kahoot! support self-paced, interactive grammar practice (Wang, 2015), but they often lack focus on younger learners. JarQuest addresses this gap by combining gamification, visual progress tracking, and targeted grammar practice, offering an engaging and age-appropriate tool for primary students in Malaysia.

3. METHODOLOGY

The development and evaluation of the JarQuest system involved a mixed-methods approach, combining system design principles with user feedback to ensure its effectiveness and usability in a primary school setting.

The system design and development of JarQuest began with a needs analysis, carefully conducted to pinpoint the specific challenges that primary school students encounter in grammar acquisition and to identify the limitations inherent in traditional teaching methodologies. This initial analysis was crucial, as it directly informed the design requirements that guided the creation of the JarQuest system. Following this, the system was intentionally designed to incorporate gamification elements, including points, levels, and rewards, alongside visual feedback mechanisms, such as the animated jar. This design choice was grounded in established principles derived from game-based learning theories (Prensky, 2001) and motivational design strategies (Deterding et al., 2011; Hamari et al., 2014). Finally, the JarQuest system was developed through an iterative process, allowing for ongoing refinement of the prototypes based on continuous feedback obtained from teacher trainees.

The evaluation of the JarQuest system involved teacher trainees who participated in trialing the system and providing initial feedback. Data collection during the evaluation process included gathering system usage data, which detailed how the teacher trainees interacted with the system, and qualitative feedback collected through open-ended questions and discussions with the teacher trainees, focusing on the system's design, usability, and its

potential for practical application in classroom settings, with the aim of identifying key themes and pinpointing areas where improvements could be made to the JarQuest system.

4. RESULTS AND DISCUSSION

The JarQuest system successfully increased student participation in quizzes by using a gamified reward approach. This way, students will be motivated to answer more questions correctly to fill their animated jars, which visually track their progress. The monthly reset of the jar encouraged consistent engagement, as learners aimed to improve their performance each month. With each correct answer contributing to their progress, learners were encouraged to perform better in a more engaging, low-pressure environment.

Furthermore, feedback from users showed that the system made learning more enjoyable, the competitive yet non-pressure environment also fostered a positive attitude in students toward repeated learning. This shift is critical in primary and lower-secondary education, where fostering intrinsic motivation is just as important as delivering content. So, by gamifying repetition, JarQuest minimizes the stress of learning and maximizes the enjoyment of the users. JarQuest received an average rating of 4.85 out of 5, based on 13 students and teachers' evaluations as portrayed in Figure 1 below. The bar chart shows a strong skew toward high satisfaction, with 11 out of 13 students (84.6%) rating the system a perfect 5 stars, while the remaining 2 students (15.4%) rated it 4 stars. However, most importantly, no respondents rated it below 4, indicating universal satisfaction with the system.

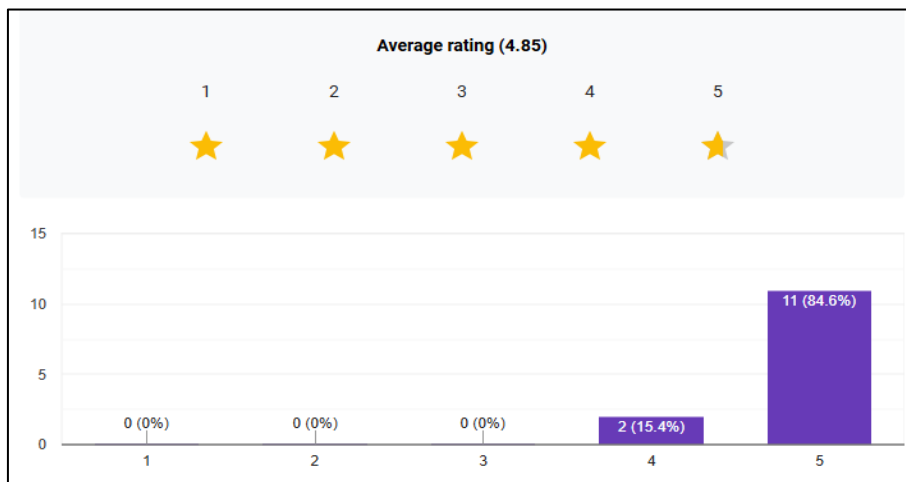


Figure 1: Average rating of JarQuest

However, while the majority of students remained highly engaged, a small percentage (15.4%, or 2 out of 13), as displayed in Figure 2, admitted that the system started to feel repetitive over time. To combat this, respondents proposed several suggestions for increasing engagement like themed challenges, team jars for collaborative learning, voice backgrounds and enhanced animations and many more. These suggestions align with best practices in game design, where personalization and variety are key to long-term engagement.

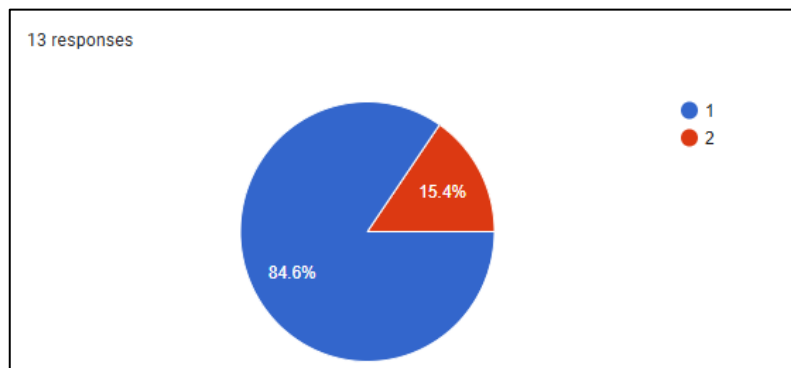


Figure 2: Percentage of responses on whether JarQuest feels repetitive

Overall, JarQuest proves that gamified learning can make education more interactive and rewarding, paving the way for innovative teaching tools. While certain areas, such as reward variety, long-term progress tracking, and collaborative features, present opportunities for improvement, the initial implementation has proven to be highly effective. With ongoing updates and refinements based on student feedback, JarQuest has the potential to become a staple tool for 21st-century classrooms.

5. VISUALS



Figure 3: The front page of the JarQuest website

Figure 3 displays the main landing page of the JarQuest website, designed as an interactive and student-friendly digital platform aimed at improving English grammar proficiency. The interface features a clean layout, intuitive navigation buttons, and visually engaging elements to attract and retain young learners' attention. It serves as the central hub from which students can access various grammar quizzes and learning resources.



Figure 4: The front page of one of the quizzes for Year 5 students

Figure 4 showcases the interface of a grammar quiz tailored specifically for Year 5 students, following the KSSR syllabus. The quiz page includes clear instructions, multiple-choice questions, and interactive elements to support autonomous learning. The layout is designed to be simple yet engaging, encouraging students to practise grammar in a fun and effective manner.

6. CONCLUSION AND RECOMMENDATION

JarQuest offers a creative and effective way to modernise grammar learning through gamification. With its unique jar-filling reward system, it transforms traditional quizzes into an engaging experience. Visual progress indicators, points, levels, and monthly resets promote a sense of achievement and friendly competition. These features not only encourage regular participation but also make learning enjoyable, helping students build a positive attitude towards grammar. The blend of repetition and rewards supports motivation and boosts knowledge retention, making JarQuest a strong bridge between learning and play.

To maximise its impact, JarQuest should first be tested in various classroom settings to gather feedback and assess its effectiveness. Expanding its quiz topics and difficulty levels can help engage a wider range of learners. Enhancements like digital badges or certificates could further motivate students. Teachers should be trained to integrate JarQuest into their lessons and use its features for progress tracking and personalised learning. Long-term studies would help compare its impact to traditional methods, and making it accessible on mobile devices would improve scalability. With these improvements, JarQuest has the potential to become a powerful tool in modern education.

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Chapter 12

Mental Wellness Application (Serenify)

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ABSTRACT

Mental health issues such as anxiety, depression, and burnout have become widespread concerns, especially among students and young adults. According to the World Health Organisation (WHO), mental disorders significantly affect emotional well-being, lower productivity, and contribute to physical health problems. In Malaysia, the situation has worsened in recent years, with rising mental health cases emphasising the urgent need for accessible, affordable, and stigma-free care. Despite growing awareness, challenges such as societal stigma, limited access to resources, and lack of personalised support continue to prevent individuals from seeking help. To bridge this gap, Serenify was conceptualised as a comprehensive digital mental wellness application offering a holistic solution. The name “Serenify” is a coined term derived from the noun serenity (calm and peace) and the suffix -ify (to make or become), symbolising the aim to foster calmness and emotional balance. Serenify addresses current challenges by offering basic stress management techniques, mindfulness practices, and an online booking system for professional consultations. Unlike other apps focusing on a single feature like guided meditation or self-assessment, Serenify integrates multiple components into one platform, enabling users to manage their mental health journey effectively. Personalised features include daily trackers for mood, mental health, and sleep quality, providing users with actionable insights. Developed using a user-centred design (UCD) approach via Figma, the app includes interactive features like breathing exercises, sound therapy, and a counselling booking system with smooth navigation. Currently at Technology Readiness Level 5 (TRL5), Serenify is being tested with a small user group to guide improvements. The application also has business potential through subscription plans, in-app purchases, and corporate partnerships. Ultimately, Serenify aims to remove barriers to mental health care while promoting resilience, self-awareness, and community well-being

Key Words: Mental Health, Stress Management, Mental Wellness Application, Accessibility to Mental Health Care, User-Centered Design (UCD)

1. INTRODUCTION

In recent years, the frequency of mental health issues such as depression, anxiety, and burnout has increasingly become a major concern in society, especially among students, young adults, and working professionals (X. Liu & Wang, 2024). According to data recorded by the World Health Organization (WHO) from studies conducted between 2019 and 2025, psychological disorders are among the most common factors contributing to decreased productivity, unstable emotional well-being, and physical health complications. Even in Malaysia, there has been a surge in mental disorder cases, which has become a growing concern and highlights the urgent need to address discrimination in mental health service delivery within the country (Raaj et al., 2021). Many individuals struggle to access affordable and proactive mental wellness resources due to stigma, lack of understanding, or a scarcity of professional care (Muhorakeye & Biracyaza, 2021). This gap in accessibility and personalized support calls for an immediate solution that enables individuals to manage their mental health effectively.

Serenify is designed to address these issues by providing a user-friendly platform that incorporates stress management techniques, mindfulness practices, and emotional self-regulation tools. The app plays a crucial role in encouraging users to build resilience and improve their overall mental and physical well-being. Serenify promotes accessibility by offering resources in a digital format, ensuring that users can access help and support anytime and anywhere. It aspires to dismantle traditional barriers to mental health care and challenge societal perceptions surrounding mental health.

2. LITERATURE REVIEW

The increasing awareness of mental health issues has led to the innovation of mental health management particularly in mobile applications. There are few mobile applications designed to help people in managing their psychological health using different approaches to psychological health such as Headspace, Smiling Mind, and Evernote (Flett et al., 2018; Hwang et al., 2021). Studies have found that these applications have proven to be effective to the users (Coelhoso et al., 2019; Flett et al., 2018). Research by Flett et al., (2018) and Coelhoso et al., (2019) did research on the effectiveness of Mental health mobile applications by conducting research on university students. The study found that the applications did significantly improve the mental health of the students. Although the studies focussed on different type of approaches, it is still proven that these applications did improve the users' psychological health.

However, these applications are focusing on different types of psychological health such as guidance for mindfulness, self-assessment or professional consultation (Lecomte et al., 2020). It can be concluded that there are no studies found in an application that integrate several features that focus on different types of mental health management. Hence, to address the gap, the researchers will design an application that has these features in one application.

3. METHODOLOGY

The development of Serenify follows a user-centered design approach to ensure functionality, accessibility, and user-friendliness. Unlike other mental health applications that focus on a single feature, Serenify integrates three key components: (1) Stress Management Techniques, (2) Daily Trackers, and (3) Counselling Session Booking System. This combination helps users move smoothly from understanding their mental state to managing stress and getting professional help. The application's personalised nature makes it unique, as users can monitor their mental health, sleep quality, and mood through daily trackers. Additionally, the seamless booking system enables users to connect with professionals online, eliminating accessibility barriers and offering flexibility. Beyond individual benefits, Serenify aims to promote societal well-being by increasing awareness of mental health management and fostering a more resilient community.

The design and development process is conducted using Figma, an interface design tool that enables a collaborative and interactive approach. Prototypes and interactive components are created to simulate real usage situations, ensuring interactivity and responsiveness in key features. The Stress Management Techniques section, which includes Breathing Exercises, Mindfulness Practices, Progressive Muscle Relaxation, and Quick Stress Relief Tips, are developed using Figma's variant and prototyping functions to enhance user engagement. Features such as color-shifting buttons, interactive animations, and smooth transitions are implemented through smart animate and variant components to create a more engaging user experience. The design process follows an iterative prototyping and testing approach, ensuring that all interactive elements function effectively before finalising the user interface. All information, content, and advice integrated into Serenify are adopted and adapted from credible mental well-being sources, with proper acknowledgements provided. This structured methodology ensures that Serenify is not only a polished and operational mental wellness application but also an effective tool in helping individuals manage stress in a comprehensive, user-friendly, and innovative way.

4. RESULTS & DISCUSSION

Technology Readiness Level (TRL) is the measurement model that is used to determine the maturity level of a technology or software (NASA, 2023). It is a nine-step model ranging from TRL1 (early research) to TRL 9 (fully operational use). The Serenify app is at the TRL5 stage, which implies it has been tested in a context environment through a small user base. We have designed the app through Figma with thorough research and relevant models on content terms and a prototype has been developed and tested on a small user base in order to test its functionalities, enabling us to establish areas of improvement (Yfanti & Sakkas, 2024). The survey utilized a Likert scale to assess various aspects of the app, categorized into Usability, Functionality, Content Quality, User Engagement, and Visual and Aesthetic Appeal. The results of the user feedback collected on the Serenify application prototype are as follows:

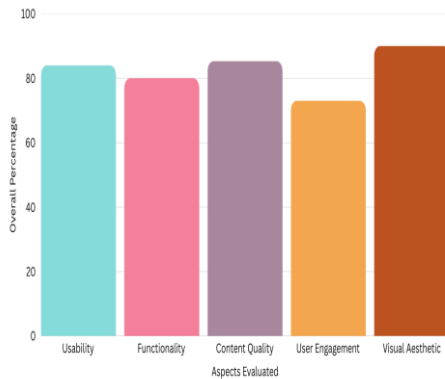


Figure 1: Overall User Feedback

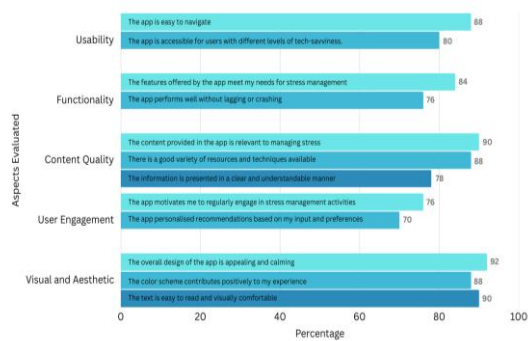


Figure 2: User Feedback in Subcategories

The survey results are an overall evaluation of the performance of the Serenify app across several important aspects like usability, functionality, content quality, user interaction, and visual appeal. All these factors play an important role in the overall user experience and the app's efficacy in stress management.

4.1 Usability

88% of the users agreed that the app was simple to use, indicating a positive user experience in accessing features and information. 80% believed that the app is accessible to users with varying levels of tech-savviness, indicating that it is appropriate for various audiences. Thereby having a usability score of 84%. High usability and compatibility of users with tech-savviness suggested that Serenify is easy to navigate, and crucial in stress management.

4.2 Functionality

84% of the users indicated that the features offered are adequate to meet their stress management requirements, reflecting the performance of the app in meeting user demands. 76% indicated that the app functions well without freezing or crashing, a necessity to attain a seamless user experience. Overall, 80% functionality. Therefore, the application has a high rate of stability and these reassure the users to have smooth and engaging experiences in using the application.

4.3 Content Quality

For content quality, 90% ensured that the content provided is helpful in managing stress, indicating that the users view the information as helpful. 88% indicated a good variety of resources and approaches provided, which can be adapted to different user tastes and needs. 78% felt that the information is presented well and clear to understand, which is vital for effective communication. Despite high levels of content quality, the lower levels in terms of clarity in information presentation highlights a need to improve. After all, this application strives to relieve stress to the users, not cause stress with unclear information.

4.4 User Engagement

76% of the users indicated that the app motivates them to practice stress management regularly, which signifies that the app is doing a great job in encouraging positive behavior. 70% agreed that the app provided personalised recommendations based on their input, enhancing user satisfaction and personalization.

4.5 Visual and Aesthetic Appeal

92% of the participants considered that the general appearance of the app was beautiful and soothing, which is a fundamental aspect in a stress management application. 88% concurred that the color scheme has a positive effect on their experience, and therefore user satisfaction is regulated by aesthetics. 90% thought that the text is easy to read and pleasing to look at, which is a very important aspect in user engagement. With this, visual and aesthetic appeal is proven to be one of the strengths of Serenify application, as it is found to be visually calming.

Overall, the survey responses highlight the positives of the Serenify app from various points of view. To improve the application, the prototype must be tested in a larger setting with a higher control group. This will enhance the validity of the test results and provide more detailed information regarding Serenify's performance and user experience. Additionally, securing the intellectual property rights will further Serenify's unique features and position it as the leading digital health tool in stress management niche.

5. CONCLUSION & RECOMMENDATION

In conclusion, Serenify is more than just a stress management app. It is an innovative and impactful digital tool that promotes mental well-being, self-awareness and accessibility to professional support. With further development and strategic implementation, Serenify has the potential to become a leading mental wellness platform, fostering healthier individuals and a more resilient society. The application also has a huge potential in both business development and intellectual property rights. In the interest of long-term viability and protection against unauthorised use, it is essential to secure intellectual property (IP) rights for the Serenify application. Obtaining trademark registration and software copyrights in the future will ensure the application's exclusivity and render its position in the market stronger. Hence, with these business and intellectual property strategies, Serenify will be poised to become a leading mental wellness app, with the promise of sustainability and innovation in digital mental healthcare.

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Chapter 13

Flexible Sliding Window

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ABSTRACT

Contemporary window designs significantly improve user comfort, safety, and overall convenience, especially for occupants of high-rise buildings. Conventional window systems often present difficulties in terms of limited ventilation and challenging cleaning access, particularly for the elderly, individuals with disabilities, and residents of condominiums. Thus, this project introduces an innovative solution called the Flexible Sliding Window, an automated sliding window that can rotate up to 180°, allowing for easier maintenance and improved airflow. The development process includes several essential stages: conceptualization, 3D modeling using Autodesk Inventor 2016, careful selection of materials like aluminium 6061 and acrylic sheets, machining with computer numerical control (CNC) and traditional machines, and integration of automation elements such as direct current (DC) motors and speed controllers. Prototype testing confirmed that the Flexible Sliding Window functions efficiently and aligns with the intended design criteria. Performance evaluation showed that the system significantly reduces window cleaning time by 3–5 minutes compared to conventional louver-type windows while enabling seamless 180° rotations with controlled speed. Structural analysis conducted through Autodesk Inventor validated the robustness of the design, with aluminium providing excellent strength and corrosion resistance. Project findings revealed that core features, automated operation, complete rotational capability, and user-centered design effectively solve issues related to cleaning and ventilation, offering a reliable and safer alternative. Proposed enhancements for future versions include incorporating rain sensors and utilizing solar power for energy efficiency. This project met its objectives successfully and presents promising potential for use in residential and commercial buildings. The Flexible Sliding Window satisfies modern user demands and demonstrates valuable innovation within the architectural and manufacturing sectors. Future research is encouraged to evaluate long-term functionality, improve child safety features, and explore certification for broader commercialization.

Key Words: automated sliding window; high-rise; design; aluminium; user-centered design

1. INTRODUCTION

Window systems are fundamental components in architectural design, providing access to natural light and ventilation while enhancing energy efficiency and safety and creating a clean, spacious, and visually pleasant environment (Hafez et al., 2023; Kim & Yu, 2018). High-rise buildings, with their challenging window designs, require expert cleaning services involving careful planning, strict safety measures, skilled staff, and reliable equipment to ensure safe and effective maintenance (Shaw, 2022). This issue is significant for the elderly, those with disabilities, and residents of multi-story buildings when access to external window surfaces is limited.

2. LITERATURE REVIEW

Traditional windows, such as louver and casement models, often limit airflow and are challenging to maintain, particularly in high-rise applications. Abdulrahman (2000) stated that modulated louvered windows struggle with reduced airflow at steep angles, wind sensitivity, and complex performance factors. While modern homes increasingly adopt sliding windows for improved access, these systems still lack flexibility and pose safety challenges during maintenance. The concept of rotatable or reversible windows has been proposed in limited architectural applications, primarily in commercial settings. However, many ventilation systems still follow rigid, traditional models and overlook more flexible, user-focused innovations, mainly due to practical challenges like cost, design complexity, and lack of conceptual planning (Seuntjens et al., 2022).

Material selection is another pillar of successful window system development. For high-rise buildings, aluminium alloy 6061 is commonly used because it offers low weight, strong corrosion resistance, and good machinability, with enhanced strength and wear resistance when reinforced (Adediran et al., 2021). A previous study highlighted that the presence of aluminium in aluminium-plastic co-extruded window systems with low-emissivity glazing offers long-term energy efficiency, structural resilience, and climate suitability, making them ideal for sustainable use in high-rise buildings in warm, humid regions (Mo et al., 2024).

3. METHODOLOGY

3.1. Materials

Aluminium is used for the frame (durable and corrosion-resistant), the acrylic board is used as the window panel material (lightweight and easy to maintain), bearings enable 360° rotation, wiring, and locking items are used for the mechanism of sliding automation, and safety lock integration.

3.2. Product development (design)

In developing the Flexible Sliding Window, the design process was carried out first as it directly relates to the subsequent machining process. This process is facilitated using

Autodesk Inventor software to generate 2D and 3D engineering drawings that visualize the selected concept.

3.3. Product development (prototype)

The necessary manufacturing processes were decided from the completed engineering drawing produced by Autodesk Inventor software. Figure 1 illustrates the various processes involved in constructing the Flexible Sliding Window. It starts with measuring the raw materials to match the required specifications from the engineering design. Next, the materials are cut to size using a Power Band Saw machine, ensuring they align with the initial measurements. This is followed by a refining stage, where the edges and surfaces are smoothed and adjusted using a SINO CNC milling machine, Creality Ender 3 S1 Pro 3D Printer and a conventional milling machine to achieve accurate dimensions. Finally, the wiring process is carried out, where all necessary electronic components are connected based on the planned circuit to enable the window's functionality.

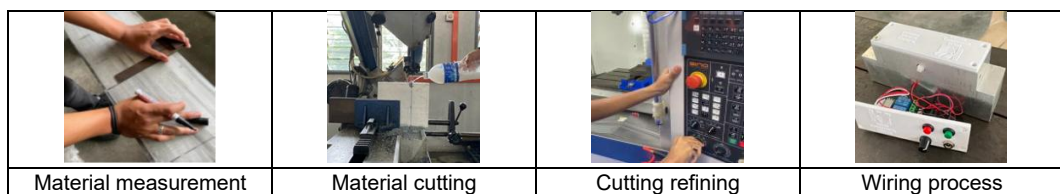


Figure 1: The steps involved in producing the prototype of the Flexible Sliding Window

3.4. Product testing

The product testing process was divided into two main parts: (1) evaluating practical performance and (2) analyzing structural strength. The practical performance was evaluated based on its effectiveness in aiding users with window cleaning. The automatic rotation function was activated at both low and high-speed settings to examine the smoothness of operation, system responsiveness, and stability during use.

4. RESULTS AND DISCUSSION

4.1. Product development (design)

Figure 2 (a) shows an initial drawing that captures the key features of a design concept without detailed information. Based on this product sketch, the technical drawings were later produced using Autodesk Inventor software, as shown in Figure 2 (b). The isometric drawing is created to provide a comprehensive view of the Flexible Sliding Window design. Detailed descriptive information about the shape and structure of the product is presented in Figure 3.

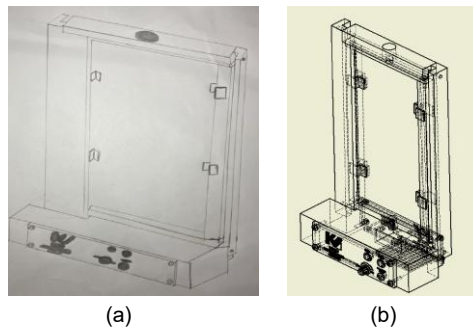


Figure 2 (a) Idea Drawing (b) Isometric Drawing

Figure 3 displays the view of the Flexible Sliding Window assembly, accompanied by a detailed parts list. This technical drawing outlines the structure and positioning of each individual component, offering a clear guide for the assembly and construction of the prototype. The diagram features 20 labeled components, each marked in the visual layout and listed in the adjacent table. This view is a critical reference during construction, enabling accurate alignment and fitting of all parts.

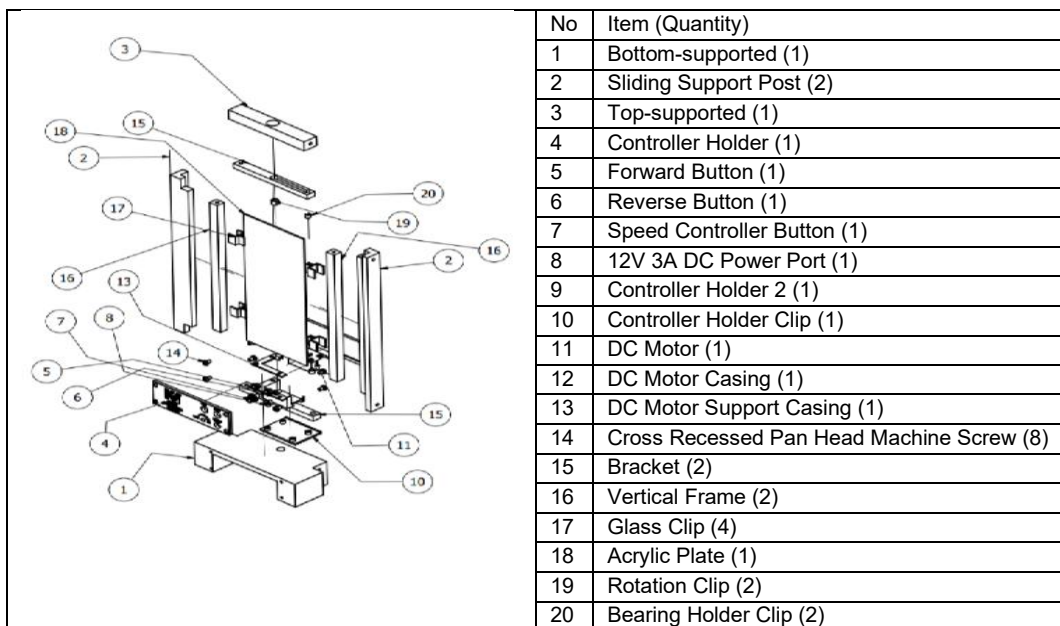


Figure 3 Parts List of the Flexible Sliding Window

4.2. Product development (prototype)

As shown in Figure 4, the developed prototype offered clear advantages compared to conventional sliding windows, particularly in functionality and user convenience.

	Product Specification Material: Aluminium 6061 Weight: 2.5081 kg Color: Silver Function: Flexible Sliding Window designed to simplify the window glass cleaning process and provide better ventilation for users

Figure 4 Prototype produced with its specification

4.3. Product Testing

The window glass rotated smoothly and functioned well. The result was that cleaning a traditional louver window typically takes 10–15 minutes, while the Flexible Sliding Window reduced the cleaning time by approximately 3–5 minutes. Table 1 summarizes info obtained from the ANSYS Mechanical report. Based on the material analysis, the Flexible Sliding Window is well-suited for real-world use due to its strong, lightweight, and reliable construction. The primary material, aluminium 6061, provides excellent structural integrity with a high yield strength, tensile strength, and stiffness making it resistant to bending, twisting, and environmental stress. Its low density ensures smooth sliding and rotation.

Table 1 Material Selection and Mechanical Properties of Flexible Sliding Window Components

Material	Component(s)	Density (g/cm ³)	YS (MPa)	UTS (MPa)	YM (GPa)	SM (GPa)	Remarks
Aluminium 6061	Frame, support structure, screws	2.7	275	310	68.9	25.90	High strength-to-weight ratio, corrosion-resistant
ABS Plastic	Controller holder, buttons	1.06	20	29.6	2.24	0.81	Durable and impact-resistant for electronics
Copper	Motor casing, motor components	8.94	33.3	210	117.5	43.68	Excellent conductivity, structural support
SAN Plastic	Acrylic window plate	1.068	72.3	72.3	3.57	1.29	Transparent, rigid, and easy to maintain

*YS = Yield strength; UTS = Ultimate tensile strength; YM = Young's modulus; SM = Shear Modulus

5. CONCLUSION AND RECOMMENDATIONS

In conclusion, the Flexible Sliding Window project represents a meaningful innovation in addressing everyday challenges faced by occupants of tall buildings, particularly concerning safety, ventilation, and the ease of window maintenance. The system was successfully designed to rotate 180 degrees, allowing for improved cleaning access while incorporating semi-automated components for added convenience. Several enhancements are recommended to increase the product's efficiency and appeal further. These include integrating automatic rain sensors to improve responsiveness during adverse weather and adopting solar energy as a clean and cost-saving power source. With further refinement, this window design holds strong potential to serve as a reliable, efficient, and innovative solution for modern living environments.

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Chapter 14

From Delay to Delivery: Revolutionizing FYP Evaluation with Microsoft 365 Solutions

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ABSTRACT

Efficient management of Final Year Projects (FYP) is critical to supporting student progress and maintaining academic quality. Traditional FYP processes are heavily reliant on manual operations that email-based communication, physical submissions, and general cloud storage is leading to delayed feedback, file mismatches, and inefficient administrative workflows. This project introduces an integrated and automated workflow using Microsoft 365 tools, including Microsoft Forms, Power Automate, Microsoft Lists, and SharePoint, to streamline and enhance the FYP evaluation process

Key Words: Final Year Project, Workflow Automation, Microsoft 365, Academic Innovation, Document Management.

1. INTRODUCTION

Final Year Projects represent a culmination of students' academic learning and research capability. However, the evaluation of FYPs is often hindered by outdated workflows and disjointed systems. Manual submissions, unclear communication between coordinators and evaluators, and unstructured cloud-based file storage can result in lost data, delayed timelines, and diminished academic oversight. Institutions require a more intelligent, automated solution to support the increasing scale and complexity of project management.

The need for workflow automation is particularly urgent in academic settings where administrative resources are limited, and the volume of project submissions continues to grow. Digitizing this process improves both academic rigour and institutional efficiency, offering a blueprint for scalable and sustainable innovation.

2. LITERATURE REVIEW

The transition to digital workflows in higher education has markedly enhanced institutional efficiency, transparency, and student satisfaction. Platforms like Microsoft 365 have been particularly effective, enabling automation of complex academic processes such as document submission, approvals, and evaluation tracking. Tools like SharePoint and Power Automate not only reduce human error but also facilitate real-time monitoring and accountability across multiple stakeholders, as demonstrated in the management of student internships and project workflows (Ilao et al., 2023; Huzhva, 2021). Additionally, research underscores the importance of customizing digital systems to align with academic hierarchies, as seen in role-based document access systems that improve administrative precision and traceability (Destini & Tony, 2024). In contrast, generic cloud storage platforms like OneDrive and Google Drive, while helpful for basic file sharing, lack essential academic workflow capabilities such as automated tracking, role-specific permissions, and submission validation—making them inadequate for managing structured processes like final year project evaluations (Cahyanto, 2024). Collectively, these findings affirm the value of purpose-built digital tools in elevating the operational effectiveness of educational institutions.

3. METHODOLOGY

This study proposes implementing an integrated, streamlined document management system utilizing Microsoft SharePoint, Microsoft Forms, Microsoft Lists, and Power Automate. Microsoft Forms enables structured, digital submissions of project proposals and theses, capturing essential student details and document metadata. Microsoft Lists provides a dynamic database to track submission status, feedback, and evaluator comments, ensuring transparency and efficient monitoring.

Power Automate further enhances this integrated solution by automating workflow tasks, such as routing documents to relevant evaluators, sending automatic reminders for pending evaluations, and alerting stakeholders when feedback is ready. SharePoint acts as the central repository and interface, offering a unified platform accessible to students, supervisors, and administrators for easy retrieval, management, and monitoring of submissions and evaluations.

Essentially, the pipelines for automated process from Microsoft Form to Microsoft list as depicted in Figure 1. The whole process of FYP evaluation is summarized as in Figure 2.

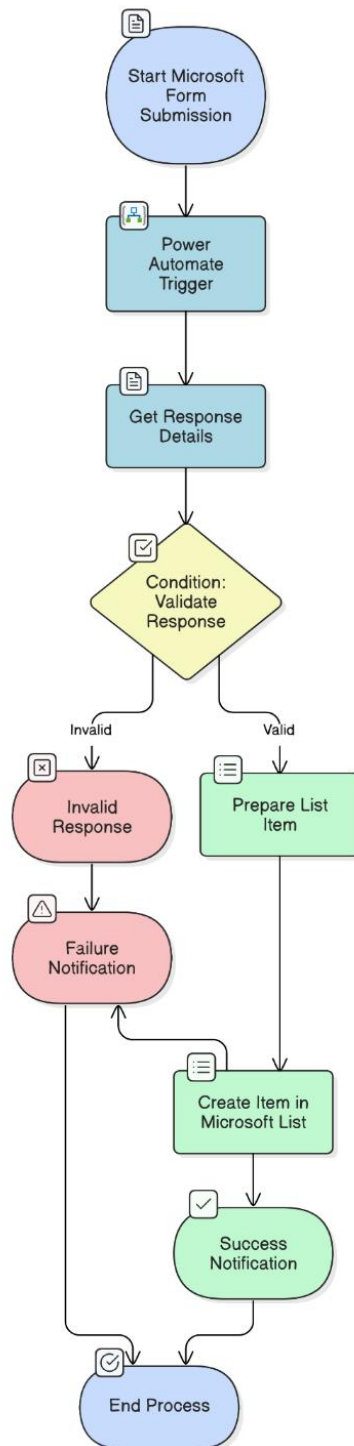


Figure 4: Automated Process: Microsoft Form to Microsoft List using Power Automate

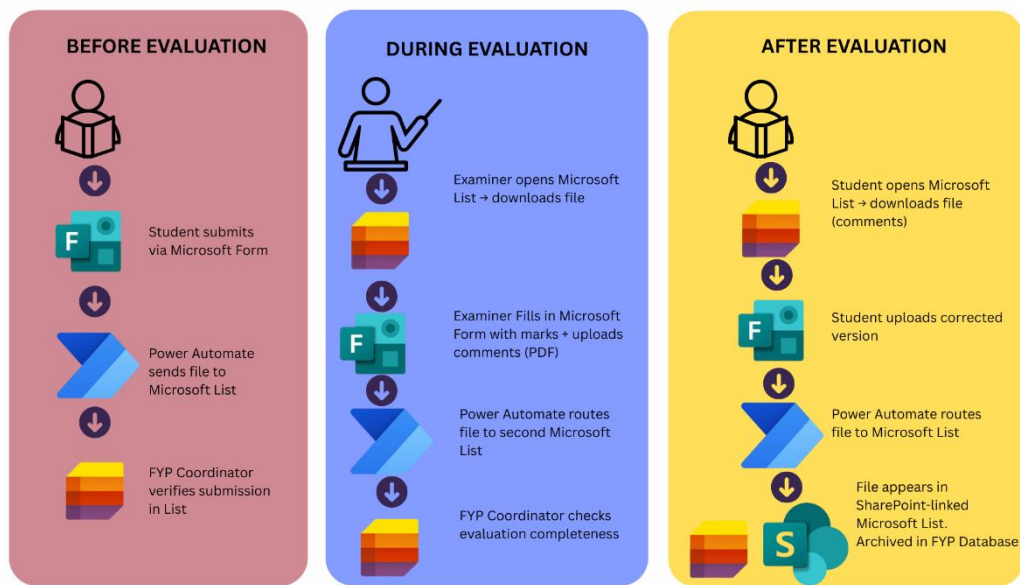


Figure 2: Three-Phase Automated Workflow for Final Year Project (FYP) Evaluation Using Microsoft 365 Tools

4. RESULTS AND DISCUSSIONS

The implementation yielded a substantial reduction in turnaround time—from two weeks to just a few days (excluding review duration). The automation eliminated errors such as incorrect file routing and missed submissions. All stakeholders reported greater satisfaction due to ease of access, tracking, and filtering options within Microsoft Lists. Coordinators could export submission records to Excel instantly for reporting, eliminating the need for manual logs.

This smart academic workflow proved superior to traditional cloud-based storage, which lacks built-in features for validation, workflow management, and version control. Stakeholders also appreciated the transparency in file tracking and evaluation status, which enabled timely feedback and reduced communication breakdowns.

5. CONCLUSION & RECOMMENDATION

This integrated Microsoft 365-based workflow offers a scalable, replicable model for academic project evaluation. It enhances transparency, accuracy, and efficiency while also contributing to environmental sustainability by replacing paper-based submissions. Academic institutions are encouraged to adopt similar systems to digitize administrative processes, minimize manual workload, and support academic integrity.

Future enhancements could include a live dashboard for performance analytics, student progress tracking, and AI-assisted tagging for early detection of missing or incomplete submissions. These additions would extend the value of the system into a comprehensive academic workflow suite.

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Chapter 15

Grammar Adventure

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ABSTRACT

Gamification in education has proven effective in enhancing student engagement, motivation, and knowledge retention, particularly in developing foundational language skills. In Malaysia, the Standard Kualiti Pendidikan Malaysia (SKPMg2) emphasizes the need for innovative and inclusive teaching methods that accommodate diverse learning needs. *Grammar Adventure* addresses this by using the Roblox platform to deliver an immersive learning experience focused on teaching adjectives to Year 1–3 students. Aligned with the national curriculum, the game features scaffolded levels, real-time feedback, and teacher analytics tools, creating an adaptive and collaborative environment for both students and educators. The game also supports educational equity through offline functionality and minimal technical requirements, making it accessible to under-resourced schools. With planned integration into Malaysia's DELiMa platform, *Grammar Adventure* illustrates the potential of game-based learning to transform grammar instruction in primary education while remaining scalable, inclusive, and curriculum-aligned.

Key Words: Gamification, Adjectives, SKPMg2, Roblox, Primary Education

1. INTRODUCTION

The integration of gamification in education has shown significant potential in enhancing student engagement and understanding, particularly in foundational subjects like grammar. Recognizing the challenges faced by young learners in mastering adjectives, in which is a core component of the Standard 1, 2, and 3 syllabus (SKPM)—this project introduces *Froggy Jumps*, an interactive game designed to transform traditional grammar instruction into an

immersive and collaborative experience. Leveraging the popularity of game among children, *Froggy Jumps* employs a video game framework to teach adjectives through dynamic quests, puzzles, and real-time feedback, catering to students (Years 1–3), primary school teachers, and IPG practicum students as well as a wider scope of users.

The game’s novelty lies in its alignment with the SKPM curriculum, offering scaffolded lessons that adapt to individual learning paces. Features such as multiplayer modes and teacher dashboards foster peer collaboration and classroom integration. Preliminary feedback from pilot tests highlights improved retention rates and student motivation. *Froggy Jumps* not only addresses gaps in remote grammar education but also serves as a model for gamified language learning in primary education.

Despite adjectives being a core competency under SKPMg2, traditional teaching methods such as worksheets often fail to accommodate students’ varied learning paces, as noted by Vygotsky (1978). *Froggy Jumps* addresses this challenge through three key strategies: first, by embedding syllabus objectives—such as the ability to identify descriptive words—directly into game mechanics to ensure alignment with SKPMg2; second, by promoting educational equity through offline accessibility, particularly benefiting rural schools as emphasized in Domain 5 (Student Support) of SKPMg2; and third, by empowering educators with analytical tools to monitor student progress, in line with the goals outlined in Malaysia’s Digital Education Policy (MOE, 2021).

2. LITERATURE REVIEW

Recent research in educational technology highlights the effectiveness of game-based learning in improving retention and engagement. Plass et al. (2020) found that well-designed educational games can boost knowledge retention by up to 40% compared to traditional methods. Roblox, in particular, has shown promise for primary education due to its collaborative features, cross-platform accessibility, and strong appeal to children aged 6–9 (Nadolny, 2020).

In Malaysia, the SKPMg2 framework, especially Domain 2.3, emphasizes “technology-enhanced student-centered learning” (MOE, 2022). *Grammar Adventure* aligns with this by offering scaffolded game levels that gradually introduce adjective concepts, while providing real-time progress tracking via a teacher-friendly analytics dashboard. This balance of pedagogy and practicality distinguishes it from more generic educational games.

Local research also supports this approach. Azman et al. (2021) reported increased motivation and participation among students using gamified grammar tools, especially those who struggle with conventional worksheets. The Universal Design for Learning (UDL) framework further reinforces the need for flexible, engaging learning paths (CAST, 2018), a principle embedded in *Grammar Adventure*’s design.

Addressing equity, the platform includes offline functionality to support rural learners with limited internet access—a key concern identified by Lim et al. (2022). This supports the goals of the Malaysian Education Blueprint (2013–2025), which emphasizes inclusive, equitable education.

By integrating evidence-based game mechanics, curriculum alignment, and accessibility features, *Grammar Adventure* offers a scalable, student-centered solution for grammar instruction tailored to the diverse needs of Malaysian primary learners.

3. METHODOLOGY

The development of *Grammar Adventure* followed a rigorous research and design process to ensure both educational effectiveness and technical robustness. The initial phase involved comprehensive curriculum mapping to identify fifteen specific adjective-related learning standards within the SKPMg2 framework for Years 1–3. These standards were then translated into interactive game mechanics using Roblox Studio, with particular attention given to creating authentic contexts for adjective application.

Technical implementation leveraged Lua scripting to create adaptive difficulty systems that respond to individual student performance, ensuring appropriate challenge levels for diverse learners. A critical innovation was the inclusion of offline functionality, enabling access for students in rural areas with limited internet connectivity. The teacher dashboard was designed to provide real-time progress tracking aligned with SKPMg2 assessment standards, allowing educators to identify students requiring additional support.

4. VISUALS OF GAME DEVELOPMENT

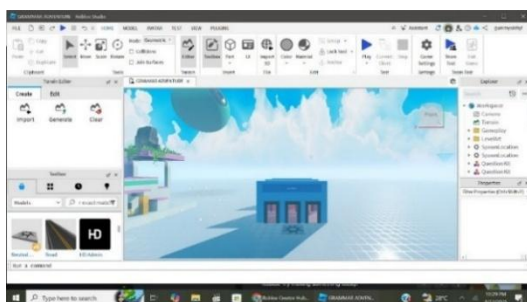


Figure 1: Game development interface in Roblox Studio showing a 3D environment in progress.

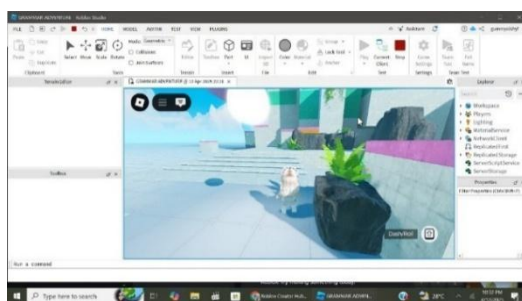


Figure 2: In-game testing of the custom-designed environment in Roblox Studio.

5. RESULTS AND DISCUSSION

The pilot testing of *Grammar Adventure* with 25 Year 1–3 students demonstrated notable improvements in grammar proficiency and student engagement. Pre- and post-assessments showed a substantial increase in adjective usage accuracy—from an average of 62% before gameplay to 87% after, representing a 25% improvement. This outcome highlights the effectiveness of embedding grammar instruction within an interactive, game-based

environment. Research has shown that such approaches help learners retain concepts better by promoting active participation and sustained interest.

Student engagement was another key area of improvement. Before using the game, learners spent an average of 8.2 minutes per session on grammar activities. After the introduction of *Grammar Adventure*, this figure rose to 22.7 minutes, nearly tripling the duration. This increase suggests that the game successfully captured learners' attention and encouraged longer, more focused participation. Informal classroom observations during testing also indicated greater enthusiasm and collaboration among students when using the game, reflecting high levels of intrinsic motivation and positive emotional responses.

Commercially, the project showed encouraging results. The RM5 per-user pricing model was deemed affordable and attractive across multiple user groups. Schools involved in the pilot expressed interest in incorporating the game into their English language curriculum, highlighting its curriculum alignment, user-friendliness, and potential to enhance lesson delivery. Several lecturers from teacher training institutes (IPGs) also showed interest in using the platform to help practicum students develop more engaging and differentiated grammar lessons.

Parental feedback further supported the game's value. Many parents appreciated the game's affordability and saw it as a useful educational tool, especially in comparison to costly tuition classes or mobile apps that rely on in-app purchases. The game's educational content, safe environment, and ease of use were consistently praised.

Additionally, *Grammar Adventure* is designed with inclusivity and accessibility in mind. Its offline capabilities and low technical requirements make it suitable for deployment in rural or under-resourced areas, helping to close educational gaps. This directly supports SKPMg2's Domain 5, which emphasizes equitable student support and access to quality learning tools.

In conclusion, *Grammar Adventure* effectively enhances language learning, increases engagement, and offers an affordable, scalable, and accessible solution for grammar instruction in Malaysian primary schools.

6. CONCLUSION & RECOMMENDATIONS

Grammar Adventure represents a successful integration of game-based learning principles within the Malaysian national education framework. Through its alignment with the SKPMg2 syllabus and its innovative use of interactive gameplay, the project has demonstrated that digital interventions can effectively support grammar instruction, especially in early primary education. The significant gains in both learning outcomes and student engagement observed during the pilot phase underscore the value of combining curriculum-driven design with engaging digital tools.

Given the positive results, several recommendations emerge for stakeholders involved in educational development and policy-making. For the Ministry of Education, incorporating educational games like Grammar Adventure into national programs, such as the Digital Learning Toolkit and school-based innovation grants, would encourage wider adoption and formal recognition of game-based pedagogy. Such support could be particularly impactful in rural and under-resourced areas where traditional methods may fall short in engaging learners.

For developers and instructional designers, the next phase of development should involve expanding the game to cover additional grammar topics while preserving the proven pedagogical structure that supports differentiated learning. Including multilingual support and

culturally relevant scenarios could further enhance the game's relevance across Malaysia's diverse classroom contexts. Additionally, integrating the platform with Malaysia's DELIMa digital ecosystem would streamline access and usage for teachers and students alike, enhancing both reach and functionality.

From a research perspective, there is a strong case for conducting longitudinal studies to examine the sustained impact of game-based grammar instruction on students' academic performance. While initial findings are promising, understanding how continued engagement with such platforms influences standardized test results and language proficiency over time would provide deeper validation of their educational value.

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Chapter 16

EKSA Performance Calculator (EPeC) Data Sphere

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ABSTRACT

The EKSA framework expands upon the 5S method by include Agency Diversity, Green Practice, Corporate Image, Creativity and Innovation. Additionally, EKSA should also be viewed a program that promotes public sector departments and agencies to be more creative and imaginative in their efforts to establish a conducive work environment that is capable of boosting both the quality of service delivers and the level of productivity. Considering this, the purpose of this research is to provide the EKSA Performance Calculator (EPeC) Data Sphere as a potential means of establishing an EKSA one-stop centre that can be utilised by government department and agencies for the purpose of storing all EKSA information. It is an expansion of EPeC Smart Dashboard. EPeC Data Sphere is a user-friendly online platform that is designed primarily for higher learning institutions like universities and colleges. It is designed to facilitate the documentation and evaluation of EKSA, and its process will be easier to administer and will be accessible to the entire organisation. As a result, it would improve the implementation of EKSA and assist in the review process while also being of great assistance.

Key Words: Public Sector Conducive Ecosystem, EKSA, EKSA Performance Calculator, Data Sphere

1. INTRODUCTION

“Sort”, “Set in Order”, “Shine”, “Sustain”, and “Standardized”, are the five elements that make up the 5s. It is developed in 1995 by Japanese industrial engineers Taiichi Ohno and Eiji Toyoda, the 5s is an expanded version of the Toyota Production System (Titu et al., 2010). Through Standard and Industrial Research Institute of Malaysia (SIRIM) in particular, the government of Malaysia is determined to assist the construction in industry in its development

and success. The 5s methodology has been promoted and implemented by SIRIM since 1994 (Hashim et al., 2014). Following a 2014, rebranding of the 5s method, the Malaysian Administration Modernisation and Management Planning Unit (MAMPU) launched EKSA, which stands for Public Sector Conducive Ecosystem. The EKSA framework expands upon the 5S method by include Agency Diversity, Green Practice, Corporate Image, Creativity and Innovation (Unit Pemodenan Tadbiran dan Perancangan Pengurusan Malaysia (MAMPU), 2020). Additionally, EKSA should also be viewed a program that promotes public sector departments and agencies to be more creative and imaginative in their efforts to establish a conducive work environment that is capable of boosting both the quality of service delivers and the level of productivity (Unit Pemodenan Tadbiran dan Perancangan Pengurusan Malaysia (MAMPU), 2020). Thus, the purpose of the EKSA performance calculator (EPeC) Data Sphere is to aid the public sector especially to educational institutions of higher learning in evaluating and monitoring their EKSA implementation on a regular basis in compliance with the standard established by MAMPU for EKSA.

2. LITERATURE REVIEW

Quality is a very dynamic element where it will continue to change with the passage of time and to meet current demands and needs. Thus, public universities also need to continue to think of the latest approaches to provide the best service to customers through the strengthening of corporate identity, image and career culture. One of the higher educations in Malaysia, has implemented Conducive Public Sector Ecosystem (EKSA). His study investigates before and after implementation of EKSA and the study found out that, more neat service counter/lobby with corporate image, practical Go Green and recycling corner, cultivation of creativity and innovation in the place with neat and orderly arrangement of items (Shakil Hameed, Ekosistem Kondusif Sektor Awam (EKSA): perkongsian amalan di Bahagian Hal Ehwal Pelajar, Universiti Putra Malaysia, 2017).

In addition, EKSA instils a culture of innovation, environmentally savvy and creativity in line with stakeholder expectations. A systematic filing system to minimise customer waiting time is a clear example of creative way to serve customers quickly. It was also clarified that under EKSA, government department in Malaysia would be given a ranking, which would remove redundant procedures and save cost. The organisation would be ranked as either "Excellent" or "Good" based on their ability to meet the criteria's requirement and excellent is defined as a score of 90 to 100 percent, while good is define as a score of 80 to 89.90 percent (Boon, 2015).

Furthermore, EKSA markedly lowers expenses by utilising recycled paper and double-sided printing, while substantially reducing electricity consumption. The library image in the higher learning institution was converted into a corporate image by implementing Standard Operating procedures (SOP) instead of identifying all things. The library and workstations are systematically organised and orderly, minimising time-consuming searches for documentation. The advantages of implementing EKSA extend beyond the system itself and are comparable to those of 5S (Jalal et al., 2023).

3. METHODOLOGY

Based on the generic and components indicated in MAMPU EKSA's standards, this study developed the EPeC Data Sphere and in details its evaluation criteria (i.e., components, the items for each number of staff) using a qualitative research approach with a document review. As the foundation for the scoring system, the EPeC Data Sphere utilised the assessment and auditing model that was derived from the MAMPU EKSA Standards. This model incorporated both general and specific criteria. The assessment criteria will be prepared in the form of a checklist and Excel, thereafter they will be evaluated whether they are valid and reliable in the category of higher learning institutions, as well as whether they are practical for users and assessors.

The Excel summary contained for generic under component B which generated for the staff of Faculty of Accountancy at UiTMJ Kampus Segamat. Plus, it will be evaluated by two experts to validate and to insert marks on the tab. The Likert scales that are provided for each of criteria and components must be used by users and assessors to properly rate their scores. Every single one of the criteria will be accompanied by a unique scale as well an explanation of the scale. Once it's done, it will accumulate the calculation for the whole Faculty of Accountancy at UiTMJ Kampus Segamat for the generic and component B. Not only will the EPeC Data Sphere provide performance scores for each part, but it will also provide an overall summary that will include chart that is based on the components scores. Additionally, the interface of EPeC Data Sphere is user-friendly, which make it accessible to the organization regardless of the technical experience of its members.

4. RESULTS&DISCUSSION

EPeC Data Sphere is an innovative system that enables colleges and universities to document and evaluate EKSA. Each components performance and scores and an overall summary are provided by the EPeC Data Sphere. The Data Sphere also contains charts based on the results for each component in the EKSA implementation. It is easy to use. No user-friendly methods for evaluating EKSA implementation are known to be in use at this time, based on the research's knowledge especially for the one whole department or faculty.

5. CONCLUSION&RECOMMENDATION

For the organisation to keep track on EKSA accomplishment, the EPeC Data Sphere may drive routine monitoring. Therefore, the EPeC Data Sphere might help the organisation learn more about their EKSA implementation, which would allow them to make improvements and identify issues more easily.

This study also recommends a foster collaboration between different government agencies as well with private sectors, academia and civil society organization. This could involve joint projects, knowledge sharing and co-creation of solutions as this enhance diverse expertise and resources to get better, long-lasting results.

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Chapter 17

Perovskite Photodetector for High Speed and Secure Li-Fi Wireless Data Transmission

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ABSTRACT

In the contemporary digital environment, the shortcomings of traditional radio-frequency wireless communication, like bandwidth congestion, energy inefficiency, and susceptibility to security breaches, have become increasingly evident. Light Fidelity (Li-Fi) is a viable option, utilising visible light to convey data at exceptionally high velocities while mitigating numerous urgent obstacles. This research centres on the creation of a high-speed and secure Li-Fi system, specifically highlighting the utilisation of a perovskite-based photodetector to improve performance. Perovskite materials have garnered interest in recent years due to their remarkable optoelectronic characteristics, including elevated absorption coefficients, adjustable bandgaps, and rapid photoresponse times. These attributes render them exemplary choices for photodetectors in optical communication systems. This study involves the fabrication of a perovskite photodetector, which is incorporated into a prototype Li-Fi system aimed at showcasing efficient, real-time data transmission utilising visible light sources, including LEDs or laser diodes. The proposed Li-Fi system utilises the underutilised visible light spectrum, which is around 10,000 times wider than the radio spectrum, facilitating ultra-fast data transfer rates and mitigating spectrum congestion. The incorporation of perovskite photodetectors improves the system's responsiveness and energy efficiency, rendering it appropriate for contemporary smart city infrastructure and advanced educational settings. Moreover, Li-Fi has inherent benefits regarding data security, as light is unable to permeate opaque materials such as walls, thereby limiting signal access to certain physical areas. This study showcases a small-scale demonstration of a perovskite-integrated Li-Fi communication system, emphasising its potential to transform wireless data transmission through enhanced speed, security, and sustainability. As Li-Fi technology advances and incorporates sophisticated photodetector materials such as perovskites, it heralds a new epoch of high-performance, environmentally sustainable wireless communication networks.

Key Words: Li-Fi (Light Fidelity), Perovskite Photodetector, High-Speed Wireless Communication, Energy-Efficiency, Data Security.

1. INTRODUCTION

Researching the creation of light sensors with semiconducting materials is an essential component of contemporary technology. Sensors are crucial in a wide range of industries, including consumer electronics and environmental monitoring. Comprehending the origins and procedures involved in developing these sensors is crucial for future progress in sensor technology.

Studying the characteristics and conduct of semiconducting materials in light detection can enhance sensor efficiency and sensitivity. This understanding can facilitate the creation of sophisticated and dependable light sensors for various applications. Advancements in semiconducting materials have enabled the development of very sensitive photodetectors utilized in medical imaging and security systems. Furthermore, continued research in this field could result in the creation of smaller and more energy-efficient sensors for upcoming technological advancements.

The research of semiconducting materials in light detection has the potential to transform multiple sectors and improve everyday technology. Researchers can open new opportunities for boosting sensor performance and broadening their uses by further advancing scientific understanding in this field. Researchers can enhance the sensitivity and efficiency of PD by utilizing improvements in semiconducting materials, thus increasing their versatility and reliability for many applications. According to (L. Li et al., 2021), photodetectors, commonly known as light sensors, are essential components enabling devices to detect and respond to changes in light intensity. Semiconducting materials have emerged as promising candidates for light sensor fabrication due to their ability to convert light into electrical signals with high efficiency and sensitivity.

2. LITERATURE REVIEW

Photodetectors are essential in various industries such as telecommunications, security, and healthcare as they transform light impulses into electrical signals. Applications that require them include optical communication networks, surveillance systems, and medical imaging. This article aims to explore the significance of photodetectors across different industries and emphasize their role in driving innovation and technological advancements. The paper will analyse several types of photodetectors and their unique uses in diverse industries.

Altered the method of light collection and utilization, leading to many technical improvements across multiple industries. Photodetectors are crucial in several applications such as identifying cancer cells in medical images and improving security in surveillance systems, contributing significantly to the advancement of our society. Enhanced sensitivity, quicker response rates, and increased reliability provided by photodetectors have made them essential in the aerospace, telecommunications, and environmental monitoring sectors.

Photodetectors are expected to play a significant role in shaping the direction of several sectors as technology advances. The influence of photodetectors on technological advancements Photodetectors are essential in several industries such as telecommunications, security, and healthcare as they transform light impulses into electrical signals. This article discusses the importance of photodetectors in various sectors and how technological improvements have altered their functionalities. The transformation of light into electrical signals has led to improved precision and effectiveness in various applications,

driving innovation and advancement in the industries they serve. Ongoing research and development in photodetector technology are leading to future advancements and improved capabilities. Advancements in communication systems, medical imaging, and environmental monitoring necessitate ongoing development of photodetectors. These devices are expected to have a crucial role in influencing the trajectory of various industries as they become more sophisticated.

3. METHODOLOGY

The ITO (Indium Tin Oxide) coated glass substrate is meticulously cleaned to eliminate surface contaminants at the outset of the fabrication process. This is an essential stage in order to guarantee optimal adhesion and film uniformity during the subsequent deposition process. Initially, the substrate is washed with water and a moderate detergent to remove dust, grease, and other impurities that have been acquired during the handling process. Subsequently, the ITO glass is immersed in a beaker containing acetone and subjected to ultrasonic cleansing for 15 minutes. The dislodging of microscopic particles and the dissolution of chemical residues are facilitated by the ultrasonic vibrations. Immediately following the acetone bath, the substrate is rinsed with isopropyl alcohol (IPA) to eradicate residual solvents and purge with argon gas to reduce surface oxidation and eliminate moisture.

The spin coating technique is employed to deposit thin films on the substrate after it has been cleansed and dried. A drop of the prepared perovskite solution is applied to the center of the cleansed ITO-coated glass, which is then placed on a spin coater. The substrate is initially spun at a modest speed of 1500–2000 rpm for 20 seconds to ensure that the solution is evenly distributed. The layer is subsequently thinned, and solvent evaporation is initiated by a high-speed spin at 3000–4000 rpm for 10 seconds, resulting in the formation of a uniform perovskite thin film. This stage is crucial for the achievement of optimal surface morphology and consistent film thickness, which are essential for the performance of the device.

To improve the electronic and structural properties of the perovskite layer, an annealing procedure is implemented. In order to enhance the quality of the film and encourage crystallization, the film is transferred to a hotplate and annealed at 100°C for 15 minutes. After the top contact (C electrode) is deposited, a subsequent annealing phase is implemented to guarantee the device's stability and optimal interfacial contact. The final thin films are characterized by using FTIR spectroscopy to identify functional groups and bonding structures, UV-Vis spectroscopy to determine optical bandgap, and an LCR meter to assess electrical resistance. The efficacy of the fabrication process and the suitability of the perovskite material for use in high-speed, secure Li-Fi photodetector applications are validated by these characterization techniques.

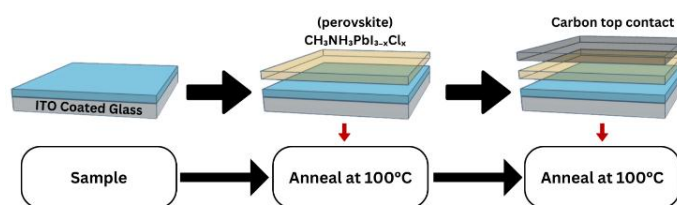


Figure 5 The PD devices fabrication protocol

4. RESULTS & DISCUSSION

The analysis of perovskite with an LCR meter provides a complete understanding of its electrical properties, which are critical for its use in light communication. The LCR meter was used to determine the resistance of the perovskite thin films, which is directly proportional to their conductivity. This test is critical in determining the material's potential as a photodetector in light communication systems, where low resistance and high conductivity are frequently needed for optimal performance.

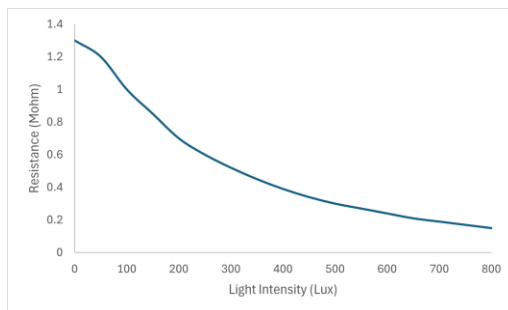


Figure 6 Resistance over light intensity

Figure 2 displays the graph from collected results that tested using LCR meter to get resistance while changing the distance of intensity of light. The light intensity is defining using light sensor on how much the lux when the distance of light has been changed. The data shows that the resistance keeps increasing when the light source getting far from the PD shows that the graph was having a direct relationship.

The resistance of the perovskite films was measured at 1 kHz frequency, where the material's response is stable and provides reliable data. The LCR meter's readings helped in identifying the resistive behaviour of the films, which is important for determining the electrical characteristics of the fabricated semiconductor. Another test has been done to see the performance of the device as shown in Figure 2.

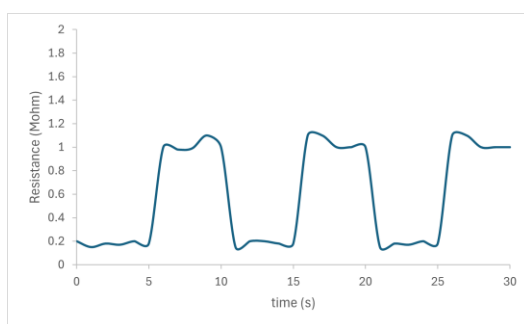


Figure 7 Resistance over time

Figure 3 shows the result of the PD that connects with LCR Meter, undergoes a specific condition for 10 seconds. The device will be having light switched on for 5 seconds and the light will be switched off for another 5 seconds repeatedly for 30 seconds with a total of 3 cycles to switch on-off the light source. This experiment is to test the performance of the

PD that has been fabricated will react to the light source to understand the electrical properties.

By performing the measurements at various conditions, we were able to study the dependence of the material's electrical properties. This is particularly important for understanding how the perovskite material behaves under different operating conditions, which can vary in practical applications like light communication. The results from the LCR meters also help to assess the uniformity of the thin films, as variations in resistance across the sample could indicate inconsistencies in the fabrication process or the presence of defects that could impact performance.

5. CONCLUSION & RECOMMENDATION

This project successfully exhibits the capabilities of perovskite-based photodetector for sophisticated light communication applications. This project created a PD with excellent responsivity by carefully selecting materials, optimizing production procedures, and conducting extensive characterization. The perovskite material, Methyl Ammonium Iodide Lead Chloride ($\text{CH}_3\text{NH}_3\text{PbI}_{3-x}\text{Cl}_x$) have exceptional optoelectronic properties, making them appropriate for these applications. The spin-coating approach, followed by thermal annealing, was successful in producing high-quality perovskite films. Optical characterization with UV-Vis confirmed the perovskite films' excellent light absorption.

This research emphasizes the scalability of the fabrication method, opening the door for possible commercial applications. The findings of this study contribute to a better understanding of perovskite photodetector technology, revealing that these materials can outperform standard semiconductors in many ways.

Additionally, integrating perovskite-based photodetectors into Li-Fi systems offers a chance to overcome some of the drawbacks of conventional wireless communication systems. Higher data transfer speeds and better signal-to-noise ratios may be made possible by perovskite materials' capacity to function across a broad range of light wavelengths. To improve system performance, future research can look into hybrid systems that combine perovskite photodetectors with cutting-edge modulation techniques. Additionally, investigating the production of photodetectors on flexible or transparent substrates may create new avenues for incorporating Li-Fi technology into wearable electronics, smart windows, and other cutting-edge uses.

In order to guarantee reliable performance in real-world applications, research can also focus on comprehending how perovskite-based photodetectors interact with environmental elements like humidity and temperature. The creation of economical and ecologically friendly production techniques that complement sustainable practices is another direction for future research. By improving these features, the use of perovskite-based photodetectors in Li-Fi systems has the potential to transform wireless communication and open the door for next-generation consumer electronics, smart cities, and effective industrial automation.

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Chapter 18

EhaiLEARN: Empowering Drivers Through English

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ABSTRACT

Unlike individuals who have the luxury of studying English in a relaxed setting over coffee, e-hailing drivers often lack the time and energy for traditional language learning methods due to long working hours spent navigating the roads. Many of these drivers face persistent challenges in improving their English proficiency, particularly through conventional classes or textbook-based learning materials, which do not cater to their schedules or learning needs. This language barrier poses a significant problem, especially when drivers interact with international passengers, leading to miscommunication, poor customer experiences, and ultimately, lower service ratings. To address this issue, EhaiLEARN was developed - a mobile English learning application specifically designed for the unique needs of e-hailing drivers. Built using the Thunkable platform, EhaiLEARN enables flexible, on-the-go learning through features such as commonly used conversational phrases, gamified activities to boost engagement, and real-time communication support to aid drivers during live interactions. The app is tailored to fit seamlessly into the mobile-centric lifestyle of e-hailing professionals, ensuring usability even during short breaks or waiting periods between rides. A freemium business model supports future scalability and sustainability, offering both free and premium features to accommodate different user needs. Preliminary testing and feedback from users have been overwhelmingly positive, indicating improved confidence and willingness to communicate in English. However, further enhancements are required to ensure optimal functionality in low-bandwidth environments—a common issue in certain driving zones. EhaiLEARN shows strong potential not only as a practical educational tool but also as an innovative entrepreneurial product that supports professional development and service excellence in Malaysia's growing e-hailing industry.

Key Words: Learning application, English, e-hailing driver, mobile app, gamification

1. INTRODUCTION

The rapid rise of e-hailing services in Malaysia, such as Grab and inDrive, has transformed urban mobility and facilitated tourism. However, a recurring issue reported by international passengers is the communication gap due to drivers' limited English proficiency. While Malaysians are generally bilingual, not all drivers are fluent, leading to confusion, miscommunication, and lower customer satisfaction. Communication challenges also impact drivers' professional requirements. As highlighted by Nathan (2019), language barriers are among the reasons many drivers fail to obtain the Public Service Vehicle (PSV) license. To address this, EhailEARN was conceived as a mobile application to improve drivers' English communication through contextual learning. The application is tailored to their needs - flexible, quick-access, and directly related to their daily interactions with passengers.

2. LITERATURE REVIEW

English proficiency is a cornerstone of effective communication in the tourism and service industry. Yusoff et al. (2021) emphasize that drivers struggle most with speaking and listening skills. This deficiency affects booking processes, directions, and general interaction with non-local passengers. Motteram (2013) and Delialioglu and Alioon (2014) support the use of mobile and gamified learning platforms, especially for adult learners with busy schedules. These tools enhance engagement and cater to visual and auditory learning preferences. Similarly, Rathivarshini, Harsha, and Divyajothi (2024) demonstrated how real-time translation systems - integrated with speech recognition and text-to-speech can effectively bridge communication gaps across cultures, reinforcing the value of technology-driven language instruction for practical use in mobile applications.

3. METHODOLOGY

3.1 Idea Generation and Planning

Initial brainstorming identified language barriers among e-hailing drivers as a key issue. A problem-driven design approach was taken, focusing on how to assist drivers in overcoming communication difficulties. The idea was refined through consultations and pilot interviews with drivers.

3.2 Development Process

EhailEARN's design began in Canva Whiteboard (Figure 1) to visualize screen flow, interface design, and key features. Development proceeded using Thunkable, a no-code platform suitable for non-programmers. The app was designed with user-friendly navigation, practical English phrases, and integration potential with e-hailing apps. Gamification, modelled after popular apps like Duolingo, was incorporated to make learning enjoyable.

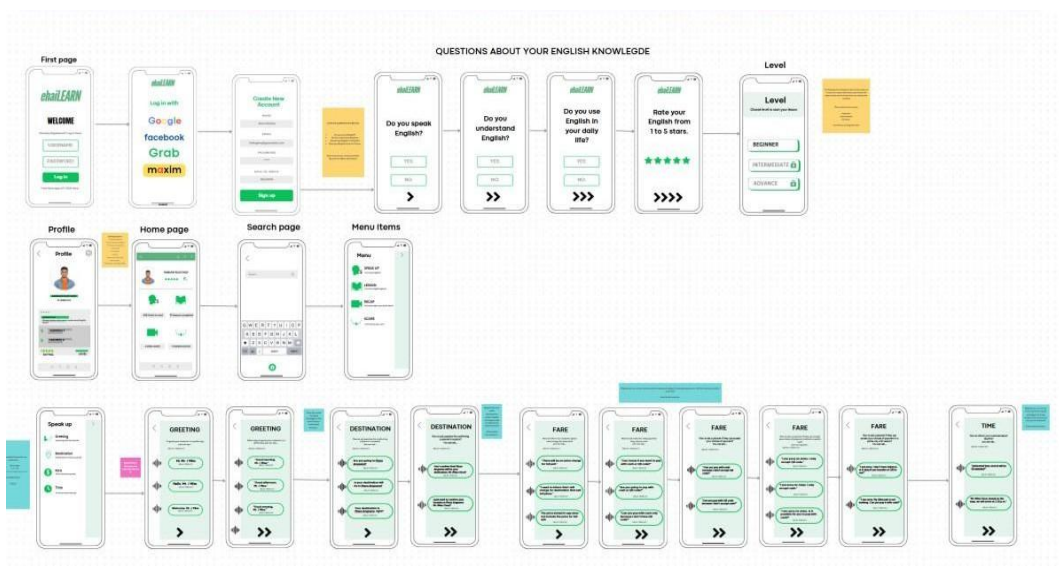


Figure 8: Application flow

3.3 Project Costing

The main expenditure was a 30-day Thunkable developer account costing RM87.48 (USD 20), necessary for deploying enhanced app features.

4. RESULTS AND DISCUSSION

4.1 App Completion and Functionality

The app was completed within 8 weeks. Although not yet published, early user feedback was promising. Testers praised its usefulness and relevance for real-world driver-passenger interactions. The application currently offers basic English learning modules, focused vocabulary, and gamified progress tracking (Figure 2).

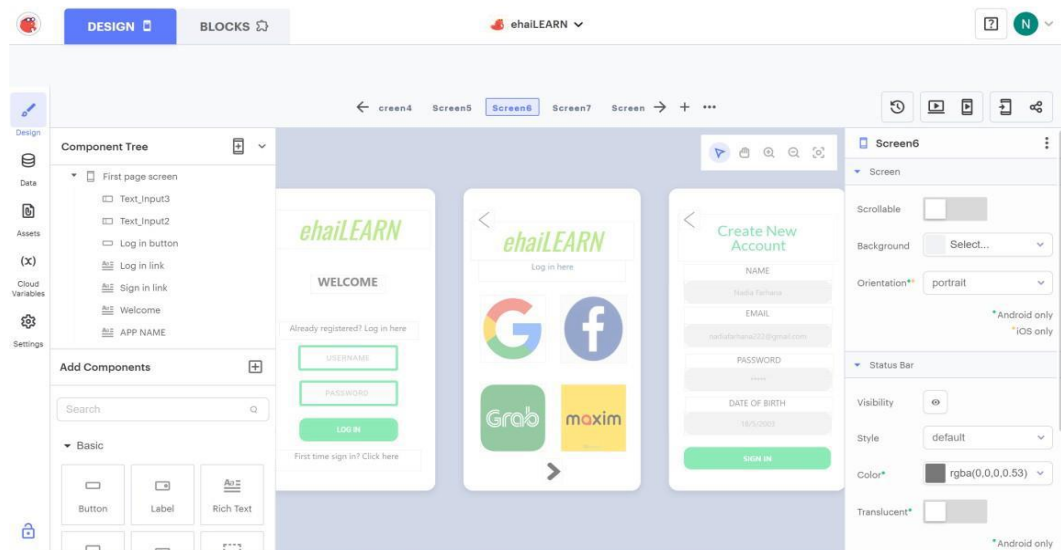


Figure 2: Application development and functionality

4.2 Opportunities

EhaiLEARN presents numerous entrepreneurial prospects that position it as a sustainable and scalable solution within the language learning and transportation industries (Figure 3). By targeting a niche market, specifically Malaysian e-hailing drivers, the app caters to a unique user group with clearly identified needs. Its design opens opportunities for corporate collaboration, particularly with major ride-hailing platforms such as Grab, Maxim, and inDrive, enabling seamless integration and broader user outreach. EhaiLEARN adopts a freemium revenue model, offering basic lessons at no cost while reserving advanced features and specialised modules for subscribers, thus ensuring continuous income generation. The inclusion of gamified learning elements not only enhances engagement but also encourages consistent usage and long-term retention. Furthermore, its cross-platform compatibility allows the app to be published on both the Google Play Store and Apple App Store, significantly boosting its accessibility and market presence.

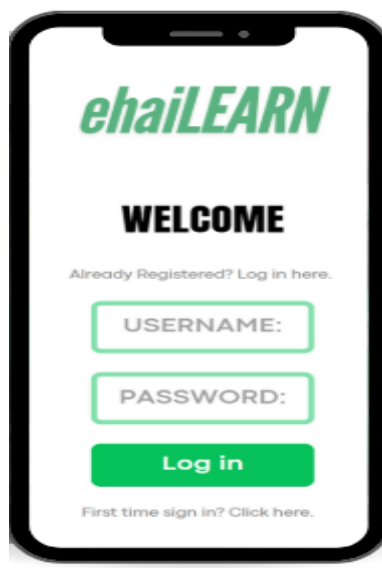


Figure 3: ehailEARN

5. CONCLUSION AND RECOMMENDATION

EhaiLEARN demonstrates a promising solution to a prevalent communication issue in the e-hailing industry. The app empowers drivers by equipping them with essential English skills, leading to improved service quality and customer satisfaction. Moving forward, developers should focus on improving performance under low connectivity and expanding content for wider linguistic coverage. With further refinement, EhaiLEARN could become a core training tool for Malaysian e-hailing drivers and a scalable product for global markets.

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Chapter 19

Computer System Hardware Installation Learning Application "Tech Tutor"

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ABSTRACT

Basic knowledge of computer systems is essential for understanding how hardware and software function. As computer usage grows, it is increasingly important for students and general users to be aware of computer system basics. However, traditional learning methods are often constrained by time and location, making it difficult for individuals to access flexible learning opportunities. Additionally, the reliance on printed reference materials contributes to resource waste and environmental harm. To address these issues, this project developed a virtual learning application focused on basic computer hardware installation. The application is accessible anytime and anywhere, eliminating the need for physical materials. It provides illustrated notes, step-by-step instructional videos, and interactive quizzes to enhance understanding. The app promotes safe installation practices and supports effective self-paced learning. The development process followed the ADDIE model and used Android Studio and Visual Studio Code as development platforms. To evaluate its effectiveness, the application includes a quiz-based assessment system that measures user knowledge after completing the learning modules. Findings from user feedback indicate positive experiences and increased knowledge levels, suggesting the app effectively supports learning outcomes. In conclusion, this virtual learning application simplifies the process of learning hardware installation while promoting digital education, reducing costs, and minimizing environmental impact. It aligns with current educational priorities by offering a sustainable, accessible, and efficient alternative to traditional methods, making computer education more flexible and environmentally responsible.

Key Words: Learning Application, Computer Hardware, Hardware Installation, Virtual Learning, ADDIE

1. INTRODUCTION

The "Tech Tutor" learning application is designed to educate users about computer hardware components such as laptops, monitors and other essential devices that are increasingly integrated into daily life. While developed primarily for vocational college students as a

supplementary learning resource beyond class hours, it is also beneficial for anyone interested in gaining hardware knowledge, regardless of age or educational background. This application provides structured access to instructional notes, reference materials, installation guides and critical safety procedures to ensure proper handling of hardware components. Interactive learning activities, including quizzes, help assess users' understanding and reinforce key concepts. The development of the app followed a systematic process, including problem analysis, design planning, implementation and testing, incorporating survey feedback to refine its features. Ultimately, "Tech Tutor" offers a convenient and effective way for students, educators and tech enthusiasts to learn about computer hardware, ensuring smooth functionality and user-friendly access to educational materials.

2. LITERATURE REVIEW

2.1 THE RELATIONSHIP BETWEEN EDUCATION AND CURRENT TECHNOLOGY

Education plays a vital role in societal development and technological advancements have significantly influenced learning methods (Kuswinardi et al., 2023). In Malaysia, the evolution of "Pembelajaran dan Pemudahcaraan" (PdPc) has shifted from conventional approaches to e-learning and now mobile learning (m-learning) (Zahari et al., 2021). Mobile applications, designed for small devices like smartphones and tablets, enhance youth engagement in knowledge-based activities. The rise of mobile learning has revolutionized education by fostering both physical and mental engagement in learning (Murat et al., 2020).

2.2 THE IMPACT OF DIGITAL APPLICATION IMPLEMENTATION IN EDUCATION

Digital applications play a vital role in modern education, making learning more accessible and engaging. According to Ismail et al. (2024), digital learning is highly relevant for today's youth. Kimlin et al. (2019) highlight how technology eases learning by enabling online courses, note-taking, project management and assignment submission via mobile devices. Hamdan et al. emphasize that mobile phones attract student interest, while m-learning facilitates knowledge access anywhere. In addition, digital applications enhance teaching by making learning more interactive and reducing student boredom (Salsabila et al., 2022). Overall, digital applications significantly improve the quality of education and learning experiences.

3. METHODOLOGY

The ADDIE model is a widely used instructional design framework that follows five key stages: Analysis, Design, Development, Implementation and Evaluation. It is applied in an iterative cycle, allowing for continuous improvements based on feedback from the evaluation phase. Each stage provides opportunities to refine and enhance the learning process, ensuring effectiveness and addressing identified weaknesses.

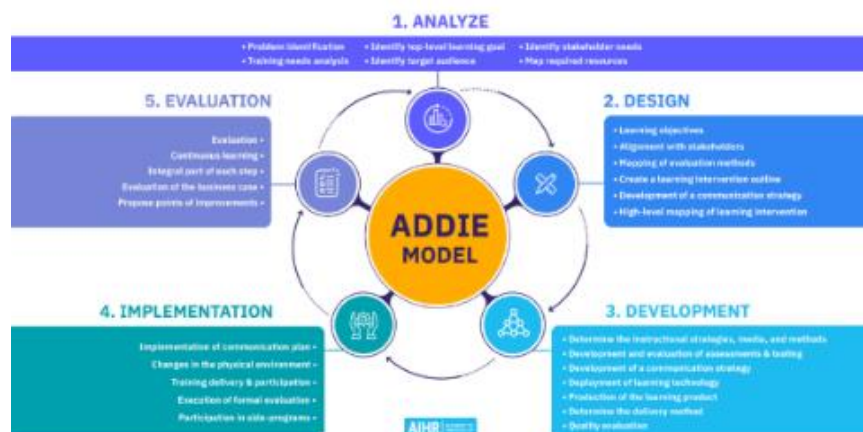


Figure 1: ADDIE Model

3.1 ANALYSIS PHASE

The Analysis phase involved data collection through a survey distributed to students and lecturers to identify problems and determine suitable solutions. Section A gathered demographic information such as age, gender and ethnicity to understand respondent backgrounds. Section B assessed their knowledge of computer technology and system hardware, while Section C focused on evaluating the desired features for the application to be developed, ensuring its design aligns with user needs.

3.2 DESIGN PHASE

This phase involves processes that illustrate relevant information in the development of the application. This includes sketches of the application's functions in diagram form. The purpose of this is to facilitate a clearer understanding of the initial structure of the application being developed.

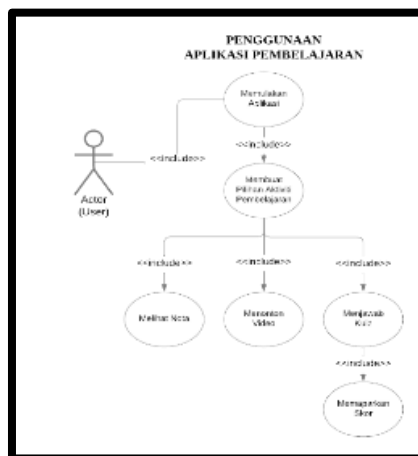


Figure 2: Application Use Case Diagram (UCD)

3.3 DEVELOPMENT PHASE

This phase involves the process of developing the application, starting with the collection of application content such as notes, videos and quiz exercises. In addition, the development process uses software such as Android Studio and Visual Studio Code along with the programmed code that has been created.



Figure 2: HTML coding for application notes, videos and quizzes

3.4 IMPLEMENTATION & EVALUATION PHASE

The implementation and evaluation phases focus on ensuring the application functions effectively and meets user needs. During implementation, the app is tested in stages and documentation and feedback are collected through Google Forms to guide improvements. Evaluation includes both formative assessments conducted throughout the ADDIE process to maintain effectiveness and summative assessments at the end to measure overall impact. The APK file is distributed for user testing and the success of the application is determined by improvements in user understanding through quiz exercises.

4. RESULTS & DISCUSSION

The Computer System Hardware Learning Application has successfully met its objectives, offering a user-friendly and interactive platform for vocational college students in Malaysia to learn computer hardware effectively. It enhances both theoretical and practical knowledge through modern digital learning tools, making access to information and lesson revision more convenient. To further improve functionality, expanding content to include computer system software, refining quiz design and increasing accessibility via the Play Store and App Store are recommended. These enhancements will improve usability, performance and the overall learning experience.

5. CONCLUSION & RECOMMENDATION

In conclusion, The Computer System Hardware Learning Application has successfully met its objectives, offering a user-friendly and interactive platform for vocational college students in Malaysia to learn computer hardware effectively. It enhances both theoretical and practical knowledge through modern digital learning tools, making access to information and lesson revision more convenient. To further improve functionality, expanding content to include computer system software, refining quiz design and increasing accessibility via the Play Store and App Store are recommended. These enhancements will improve usability, performance and the overall learning experience.

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Chapter 20

Business Adventure - The Entrepreneur's Quest

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ABSTRACT

In an era defined by innovation, entrepreneurship, and rapidly changing economic landscapes, there is a growing need for educational tools that not only convey theoretical knowledge but also cultivate practical skills and entrepreneurial mindsets. The Entrepreneur's Quest is an innovative educational board game designed to transform how business and entrepreneurship concepts are taught to diploma and undergraduate students. Moving beyond passive learning, the game immerses players in a dynamic simulation where they must navigate the complexities of starting and growing a business from launching a startup to managing a corporate empire. Unlike conventional board games, this game incorporates a structured knowledge system through tiered question cards covering management, marketing, strategy, and digital entrepreneurship. Players must answer these questions correctly to make strategic moves such as purchasing properties, upgrading businesses, and making investment decisions. This abstract summarizes a study that adopts a design-based research (DBR) methodology to evaluate the educational impact of the game among a cohort of diploma students. Data collected through observations and focus group discussions reveal that the game significantly enhances engagement, motivation, and comprehension of core business concepts. Students reported increased confidence in applying theory to practice, along with improvements in financial literacy, strategic thinking, and teamwork. The results affirm the game's effectiveness as both a revision tool and a platform for experiential learning. It encourages students to think critically, collaborate, and adapt to challenges as essential skills in today's entrepreneurial ecosystem. This paper recommends integrating Business Adventure - The Entrepreneur's Quest into entrepreneurship and management curricula to complement conventional teaching methods. It also proposes digital adaptation and content customization for broader reach and versatility. Ultimately, this gamified approach redefines how management and entrepreneurship is taught, making learning more engaging, memorable, and impactful.

Key Words: Entrepreneurship, business adventure, management, educational board game.

1. INTRODUCTION

In the evolving landscape of education, traditional teaching methodologies are increasingly being supplemented with innovative and interactive learning tools to keep pace with the digital generation's learning preferences. One such approach is gamification, which refers to the integration of game-based mechanics and thinking into non-game contexts such as education. This method has demonstrated significant promise in enhancing student motivation, engagement, and knowledge retention. In business and entrepreneurship education, where experiential learning plays a pivotal role, gamification has the potential to bridge theoretical concepts with practical application.

Business Adventure: The Entrepreneur's Quest is an educational board game designed to simulate real-world entrepreneurial experiences and strategic business decision-making in a structured and engaging environment. The game mirrors the journey of entrepreneurs as they build and manage businesses, starting from a small startup to a thriving corporate empire. Players must navigate financial constraints, market dynamics, and strategic investments while responding to unexpected events such as cybersecurity breaches, viral trends, or market crashes. Through this experiential learning platform, students not only revise their theoretical knowledge but also enhance essential 21st-century skills such as critical thinking, leadership, financial management, and adaptability.

The game employs a unique combination of structured question cards, business sectors, and scenario-based event cards (**Entrepreneur's Luck** and **Business Challenges**), offering players a well-rounded business simulation. What sets this game apart from traditional board games like *Monopoly* is its academic foundation. Players must correctly answer questions in business management, marketing, strategy, and entrepreneurship before acquiring assets. This mechanism ensures that knowledge acquisition is directly linked to game progression, transforming passive learning into an active cognitive process.

This paper presents the design, implementation, and evaluation of **Business Adventure: The Entrepreneur's Quest** as an educational intervention for diploma-level business students. The study explores how the game impacts learners' understanding of entrepreneurial concepts, their ability to apply theoretical knowledge, and their strategic thinking in dynamic business environments. The results indicate promising outcomes in both cognitive engagement and conceptual understanding, positioning the game as a valuable tool for modern business education.

2. LITERATURE REVIEW

Recent studies have emphasized the transformative potential of gamification in education, particularly in domains requiring strategic thinking and real-world application such as business and entrepreneurship. Ferri, Grifoni & Guzzo (2020) assert that gamification helps bridge the gap between abstract knowledge and practical experience, especially when students are allowed to experiment within simulated environments. Similarly, García- García-Holgado, García-Peñalvo & Rodríguez-Conde (2021) demonstrate that serious games promote learner autonomy, creativity, and entrepreneurial confidence by placing learners in decision-making roles.

Entrepreneurship education benefits significantly from tools that simulate uncertainty, competition, and innovation. According to Ab Rahman, Yaacob & Mohd Yusoff (2022),

gamified entrepreneurship learning allows students to take calculated risks and understand the consequences of their business decisions without facing real-world penalties. Mahmood, Salleh & Abdullah (2023) further argue that serious play increases entrepreneurial intention and strengthens business acumen when aligned with curriculum goals. This approach resonates with Sánchez-Mena and Martí-Parreño's (2019) findings, which indicate that engagement and motivation are heightened when learners perceive challenges as meaningful and the learning environment as immersive.

The integration of digital economy elements such as e-commerce growth, technology disruption, and globalization are also critical in preparing students for current market realities. Business Adventure: The Entrepreneur's Quest incorporates these themes through scenario cards and interactive gameplay, aligning well with emerging trends in digital entrepreneurship education.

3. METHODOLOGY

This study adopted a design-based research (DBR) methodology, involving iterative phases of design, development, implementation, and evaluation of the board game in a real educational context. The participants consisted of 30 diploma-level students enrolled in business and entrepreneurship-related subjects at a polytechnic institution in Malaysia.

Research Objectives:

1. To apply entrepreneurial decision-making in dynamic business scenarios
2. To demonstrate understanding of core management functions
3. To integrate marketing, finance, and strategy in business development
4. To foster entrepreneurial mindset and risk-taking behaviour

The game was introduced as a supplementary learning tool during workshop sessions. Students were divided into groups of 4–5 players or groups, and each session included a short briefing, gameplay lasting 60–90 minutes. Observations and focus groups were used to capture student responses and experiences throughout the sessions. How to Play the Game:

- Each player begins with a small capital and starts as a startup entrepreneur.
- Players take turns rolling a dice to move around the board.
- When landing on a property/business sector, players must answer a question card (Easy, Medium, or Hard) based on the category (Strategy, Marketing, Finance, Human Resource, Operations, etc.).
- If the answer is correct, the player can purchase or upgrade the business.
- If incorrect, they lose money or miss a turn (penalty).
- Event Cards (Entrepreneur's Luck or Business Challenge) are drawn when players land on specific tiles, simulating real-world disruptions or opportunities.
- The game involves collecting revenue, investing in marketing, taking business loans, and acquiring or merging companies.
- The goal is to build a corporate empire while maintaining financial health and making strategic decisions.

4. RESULTS & DISCUSSION

The findings indicate that students showed higher levels of participation, enthusiasm, and retention of business concepts during and after gameplay. Participants appreciated the game's requirement to correctly answer academic questions before progressing, as it motivated them to recall and apply theoretical content. The use of tiered questions also allowed students with different competency levels to participate meaningfully.

The strategic nature of the game, particularly its dynamic financial management and event response elements, encouraged players to think critically and make calculated business decisions. Game events such as "Market Crash" and "Tech Boom" simulated economic volatility, encouraging players to assess risk and adapt their strategies. The opportunity to experience business expansion, marketing investments, and hostile takeovers in a safe, simulated environment contributed to deeper learning.

Students demonstrated a more integrated understanding of business functions—especially how finance, marketing, and strategy interact in business development. Many exhibited improved decision-making and negotiation abilities as they collaborated and competed during gameplay. Players adopted entrepreneurial mindsets and showed increased willingness to take calculated risks—aligning with one of the research objectives.

Overall, the game succeeded in transforming theoretical knowledge into practical decision-making. The findings highlight the effectiveness of game-based learning as an experiential and motivational tool for business education.

5. CONCLUSION & RECOMMENDATIONS

In conclusion, Business Adventure: The Entrepreneur's Quest is a practical and engaging educational tool that supports the learning of entrepreneurship and management concepts through immersive, gamified simulation. The game's alignment with academic content, combined with its experiential format, contributes to cognitive and behavioral learning outcomes that traditional instruction may not fully achieve.

Recommendations for future implementation include Integrating the game as a recurring formative assessment tool across business modules, customizing game content to reflect specific industry trends or local business contexts, developing a digital version to support blended learning or remote education, conducting longitudinal studies to evaluate the long-term impact on entrepreneurial intention and academic performance and exploring cross-disciplinary applications. In example, integrating accounting, technology, and ethics scenarios for holistic business education.

By embracing gamified learning tools like Business Adventure: The Entrepreneur's Quest, educators can empower students with the skills and mindset necessary to thrive in the modern business landscape.

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Chapter 21

Impact of Waste Dumping on Recreation and Leisure Activities Toward Visitors: Case Study Teluk Batik Lumut Perak

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ABSTRACT

This study investigates the impact of waste dumping on recreational activities at Teluk Batik, Lumut, Perak, Malaysia, where rapid tourism growth has led to increased waste generation and inadequate waste management. These issues result in significant pollution, particularly in beaches, restaurants, and recreational spaces, diminishing the area's natural beauty and affecting visitor experiences. Using a quantitative research approach, data were collected through structured surveys and systematic observations to assess visitors' waste disposal behaviors and the extent to which waste accumulation interferes with activities such as swimming, picnicking, and beach games. The analysis employed descriptive statistics, correlation analysis, and crosstabulation techniques to identify key factors contributing to the issue. Findings highlight three primary causes of improper waste disposal: first, the lack of sufficient waste disposal facilities forces visitors to discard garbage improperly; second, limited public awareness about proper waste management further exacerbates the problem; third, poor maintenance of existing waste infrastructure, including overfilled bins and irregular waste collection, creates an unhealthy environment that reduces visitor satisfaction. The study recommends enhancing waste management strategies through the establishment of additional waste disposal facilities, improved maintenance practices, and public education campaigns to promote responsible waste disposal. By tackling these issues, the study aims to improve visitor experiences, support sustainable tourism, and ensure the long-term conservation of Teluk Batik's environment, ultimately preserving its attractiveness as a popular tourist destination while safeguarding the local economy.

Key Words: Waste dumping, Recreation, Leisure, Environmental, Conservation

1. INTRODUCTION

Coastal municipalities are facing increasing environmental challenges, particularly related to waste management. These issues are compounded in tourism-dependent areas, where the influx of visitors significantly elevates waste production, putting pressure on local ecosystems and affecting the quality of life for both residents and tourists. Teluk Batik, a notable beach town in Lumut, Perak, Malaysia, illustrates this situation well. Known for its pristine beaches, seafood, and recreational activities, Teluk Batik has become a popular destination for both domestic and international travellers. However, the town is grappling with an ever-growing waste management problem that threatens both the environment and the region's tourism industry. Improper waste disposal in Teluk Batik has caused visual and odorous pollution, particularly in areas near beaches, restaurants, and recreational facilities. The rising volume of waste due to the increasing tourist population makes current waste management practices insufficient for effectively tackling the problem. This study aims to investigate the effects of waste dumping on the recreational and leisure activities of visitors to Teluk Batik and to identify viable solutions for improving waste management in the area. The study will focus on identifying the key factors contributing to poor waste disposal and assessing the environmental and economic consequences of the situation.

2. LITERATURE REVIEWS

Waste dumping issues at Teluk Batik are primarily driven by infrastructural deficiencies, such as inadequate waste facilities, insufficient trash bins, limited recycling options, and poor maintenance, and behavioral factors, including a lack of environmental awareness among visitors. These systemic challenges lead to improper garbage disposal and open dumping practices that further exacerbate littering and environmental degradation (Bahri et al., 2020; Nguyen et al., 2023). Environmentally, the accumulation of waste causes severe visual and olfactory pollution that degrades the natural appeal of recreational spaces and deters leisure activities like swimming, picnicking, and beach sports. This pollution not only harms coastal ecosystems by contaminating water bodies and marine life but also increases health risks through air and water pollution, exposing visitors to respiratory illnesses and hazardous wildlife (Siddiqua et al., 2022; Vinti et al., 2021). Economically, the decline in environmental quality results in reduced visitor spending and diminished tourism revenues, negatively impacting local businesses and the broader community. To address these multifaceted issues, there is an urgent need for enhanced waste management infrastructure, comprehensive public education, stricter regulatory enforcement, and collaborative initiatives to mitigate the adverse environmental, social, and economic impacts of waste dumping at Teluk Batik (Chandel et al., 2022; Power, 2022).

3. METHODOLOGY

A quantitative research design was adopted to assess the impact of waste dumping on the leisure and recreational activities at Teluk Batik. Data was collected through a combination of structured surveys and direct field observations. The survey instrument was designed to capture respondents' perceptions of environmental quality, safety, and overall visitor satisfaction. Key variables measured included the prevalence of waste, odor intensity,

perceived health risks, and the frequency of leisure activity engagement. The methodology was structured to ensure a comprehensive understanding of how improper waste disposal influences both the environmental and economic dimensions of tourism in coastal areas.

4. RESULTS AND DISCUSSION

4.1 Factors of Waste Dumping Issues

Table 1 shows the analysis of factors influencing waste disposal issues at Teluk Batik, highlighting that lack of proper signage is the highest score, with a mean of 4.20 . Over half of the respondents strongly agreed that inadequate signage worsens waste dumping due to the lack of clear information on garbage disposal locations. This aligns with studies emphasizing the role of proper signage in guiding tourists and enhancing waste management awareness. Then, the lowest score mean is improper waste management by local businesses, with a score mean of 4.01. These efforts are essential to preserving Teluk Batik's natural environment, improving tourist experiences, and supporting sustainable tourism development.

Table 1: The Analysis Factors of Waste Dumping Issues

Likert Scale	(1)	(2)	(3)	(4)	(5)	Mean
Variable	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	
Lack of Proper Waste Management Facilities						
a) Trash bins not located	13 (2.8%)	22 (4.8%)	31 (6.7%)	254 (55.2%)	140 (30.4%)	4.06
b) The lack of proper signage	18 (3.9%)	37 (8.0%)	16 (3.5%)	155 (33.7%)	239 (50.9%)	4.20
c) Overflowing trash	17 (3.7%)	29 (6.3%)	17 (3.7%)	257 (55.9%)	140 (30.4%)	4.03
Open Dumping						
a) Insufficient visitor awareness	14 (3.0%)	20 (4.3%)	32 (7.0%)	259 (56.3%)	135 (29.3%)	4.05
b) Open dumping sites affect the overall recreational experience	18 (3.9%)	26 (5.7%)	28 (6.1%)	149 (32.4%)	239 (52.0%)	4.23
Local Business						
a) Improper waste management from local businesses	10 (2.2%)	33 (7.2%)	33 (7.2%)	251 (54.6%)	133 (28.9%)	4.01

4.2 The impact of waste dumping

Table 2 shows the analysis of the impact of waste dumping on the recreational and leisure activities of tourists at Teluk Batik. Recreational areas such as Teluk Batik rely on a pristine and well-maintained environment to provide enjoyable experiences for visitors. However, the presence of garbage and pollution can hinder these activities, reduce visitor satisfaction, and negatively impact the site's overall appeal. The project aims to assess the effects of rubbish disposal on leisure activities, including picnics, swimming, and other recreational pursuits. The analysis reveals that the waste dumping at Teluk Batik significantly undermines the destination's attractiveness and economic viability. The highest score

shows the effect on the local economy, with a score of 4.26. Then, the decrease in tourist activities is the lowest score mean of 3.98.

Table 2: The Analysis of The Impact of Waste Dumping

		Percentage%				
Variable	(1) Strongly Disagree	(2) Disagree	(3) Neutral	(4) Agree	(5) Strongly	Mean
Visitor						
a) Unmanaged waste disposal	3.9	5.4	7	53	30.7	4.01
b) 2. Uncontrolled waste can invite the presence of Venomous animals such as snakes	3	5.9	6.1	56.1	28.9	4.02
Recreation and Leisure						
a) Negative image	4.8	6.1	5.7	30.2	53.3	4.21
b) Reduces the number of visitors.	3.9	7	5.4	32.2	51.5	4.2
Economic						
a) Decrease in tourist activities	4.1	6.5	6.1	53.7	29.6	3.98
b) Affect the local economy	2.8	5.9	5.9	33.5	52	4.26

5. CONCLUSIONS

The data collected reveals that the waste management issues at Teluk Batik are like those identified in other coastal tourist destinations. Lack of waste disposal infrastructure and weak enforcement of waste disposal laws are common issues leading to increased littering (Fernando, 2021). The findings of this study indicate that improper waste disposal is not only an environmental concern but also has a direct impact on the recreational experiences of visitors. (Perkumiené et al., 2023). The study's findings underscore the need for effective waste management strategies and enforcement measures to mitigate the negative effects of waste on both the environment and the local economy. The recommendations outlined below aim to address the issues and contribute to the sustainable management of Teluk Batik as a tourist destination.

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Chapter 22

Visitor Experience on Night Recreation Activities at Tunku Mahkota Ismail Centre

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ABSTRACT

The rising emphasis on nocturnal recreation within urban parks has necessitated an understanding of park visitors' experience, motivation, and satisfaction. This research looks at predictors of participation in nocturnal recreation among visitors to the Tunku Mahkota Ismail Youth Centre (TMIYC) in Johor Bahru, a significant urban recreation site, and evaluates its overall recreation experience among visitors. With a quantitative design, 384 participants participated in completing structured questionnaires that measured the most critical factors influencing visitor satisfaction, including accessibility, facilities availability, security, and social interaction. Findings indicate that several factors contribute significantly to visitor satisfaction, particularly the condition of park facilities, security, and social interaction. The study discovers that well-managed environments with safe areas contribute to a satisfactory visitor experience and encourage greater participation. In addition, TMIYC's nighttime recreation has been proven to contribute positively to visitors' physical well-being, stress alleviation, and social attachment, which says a lot about its potential as an urban recreational area. Guests also have the opportunity to engage in various recreational activities, such as skateboarding, jogging, and cycling, which increase fitness and personal development. However, the study also identifies significant barriers that discourage full participation, for example, security concerns, inadequate lighting, and a shortage of proper facilities to accommodate the increased number of guests. Such barriers could deter potential visitors from enjoying full night recreational activities. To solve such issues, the infrastructure in the parks will have to be improved, illumination increased, and additional security features incorporated. Further, the research emphasizes that night recreation at TMIYC provides guests with excellent learning, networking, and skill acquisition opportunities, which add to the experience.

Key Words: Visitor Experience, Night Recreation, Activities, Facility Management

1. INTRODUCTION

The Tunku Mahkota Ismail Youth Centre (TMIYC) in Johor Bahru was inaugurated on December 21, 2020, by DYAM Tunku Ismail Idris Ibni Sultan Ibrahim. Located in Hutan Bandar Johor Bahru, it spans 15 acres with 12 main facilities, providing a welcoming space for recreational and leisure activities. Open daily from 7:00 AM to 11:00 PM, it accommodates diverse schedules and ensures accessibility. TMIYC, set within a 32-hectare forest park, plays a key role in environmental preservation and community engagement. It offers lakes, playgrounds, walking routes, and picnic sites, making it a popular nighttime destination due to its pleasant temperatures, safety, and variety of events. Night recreation activities include beam scooters, a bar area, playgrounds, and skate parks, offering opportunities for socializing, exercising, and relaxing. To further enhance the nighttime experience, TMIYC plans to introduce improved lighting, night markets, and extended hours.

2. LITERATURE REVIEW

According to the United Nations World Tourism Organization (UNWTO), a visitor is any person travelling to a place outside of their usual environment for less than 12 months and for purposes other than employment at the visited destination (UNWTO, 2022). This includes both tourists (overnight visitors) and same-day visitors (excursionists). Experience is explored through the philosophical and psychological frameworks of Dewey and Bruner. Dewey differentiates between aesthetic (complete) and ordinary experiences, emphasizing that meaningful experience is holistic and participatory (Dewey, 1934). (Bruner, 1986) adds that experience is constructed through personal narratives and is inherently subjective, shaped by an individual's background and context. The concept of night is framed both culturally and naturally, beginning after sunset and ending at dawn (A. Muhammad, 2001). Due to increasing urbanization, high daytime temperatures, and tight work schedules, night has become a preferred time for leisure and recreation in urban parks (Shaharudin et al., 2010; Oguz & Cakci, 2010). The chapter introduces night recreation as an emerging trend supported by research from (Ngesan and Karim, 2012), noting a behavioral shift toward evening leisure, which is seen as more comfortable, social, and inclusive.

3. METHODOLOGY

The research was conducted at TMIYC, a 15-acre recreational centre in Johor Bahru, known for its diverse night recreation activities and well-equipped facilities, including playgrounds, sports areas, and dedicated paths for walking, jogging, and cycling. A structured questionnaire was developed to collect primary data, utilizing a quantitative approach to ensure measurable and comparable results. Data collection was conducted through QR code links, social media distribution, and physical hard copies, with sections covering demographics, factors influencing participation, and visitor experiences while maintaining confidentiality and anonymity. The Krejcie and Morgan sampling method determined a sample size of 384 respondents using probability sampling to ensure equal representation.

4. RESULT AND DISCUSSION

4.1 Factors Contributing to Night Recreation Participation

Table 1 shows the analysis factors contributing to night recreation activities is the availability of park equipment and cooler night temperatures follow closely with the highest mean scores of 3.98 and 3.95. Well-maintained parks ensure comfort, safety, and visitor satisfaction, in line with findings by Cohen et al. (2014). Quality services, including security and cleanliness, further enhance the experience.

Table 1: Factors Contributing to Night Recreation Activities Among Visitors

Variable	Likert Scale		(1)		(2)		(3)		(4)		(5)		Mean
			Strongly Disagree		Disagree		Neutral		Agree		Strongly Agree		
	f	%	f	%	f	%	f	%	f	%	f	%	
i) Having a Friend	8	2.1	30	7.6	87	22.7	148	38.5	111	28.9	3.84		
ii) Cooler Night Temperatures	12	3.1	21	5.5	78	20.3	137	35.7	136	35.4	3.95		
iii) Feel motivated to engage in my hobbies	9	2.3	25	6.5	95	24.7	145	37.8	110	28.6	3.84		
iv) The availability of park equipment	6	1.6	24	6.3	76	19.8	144	37.5	134	34.9	3.98		
v) Easy access to the park location	7	1.8	21	5.5	85	22.1	151	39.3	120	31.3	3.93		

4.2 Visitors' Experience During Night Recreation

Visitors to TMIYC generally have positive nighttime recreation experiences, with most factors scoring close to 4.00 on a Likert scale ("Agree"). Table 2 shows that the highest-rated factors in experience during night recreation are quality of park services, with a mean score of 3.96. These contribute significantly to visitor satisfaction and frequent visits. Night recreation also enhances quality of life, with a score means 3.92 and promotes physical and mental well-being, 3.88. Then, the variety of facilities means score with 3.91 and opportunities for social interaction, 3.90 further enrich the experience. However, the skill acquisition score means with 3.83, is the lowest-ranked factor. TMIYC effectively meets visitor needs by providing safe, well-maintained, and diverse recreational opportunities.

Table 2: Visitors' Experience During Night Recreation

Likert Scale	(1) Strongly Disagree		(2) Disagree		(3) Neutral		(4) Agree		(5) Strongly Agree		Mean
	F	%	f	%	f	%	f	%	f	%	
Variable											
i. The quality of services, availability of resources, fulfilment of my needs, and the maintenance of facilities.	8	2.1	20	5.2	84	21.9	140	36.5	132	34.4	3.84
ii. The quality of services	6	1.6	17	4.4	91	23.7	152	39.6	118	30.7	3.96
iii. The variety of facilities	9	2.3	26	6.8	79	20.6	146	38.0	124	32.3	3.91
iv. Positively impacted my physical health and well-being.	12	3.1	28	7.3	78	20.3	141	36.7	125	32.6	3.88
v. Enhanced my quality of life	6	1.6	28	7.3	78	20.3	151	39.3	121	31.3	3.92
vi. New Skills	11	2.9	23	6.0	100	26.0	137	35.7	113	29.4	3.83
vii. Build new connection with many friends.	11	2.9	24	6.3	71	18.5	133	34.6	145	37.8	3.90

5. CONCLUSION

This study highlights the importance of infrastructure, accessibility, and environmental comfort in influencing visitor participation and satisfaction in night recreation activities. Well-maintained Park equipment and cooler night temperatures are key motivators, while socialization and hobbies are secondary. Safety, service quality, and facility maintenance are essential for positive experiences. Night recreation also enhances well-being, reduces stress, and promotes social connectivity. However, safety concerns, poor lighting, and limited facilities remain challenges. The park management should improve park design, security, and community engagement to foster healthier communities, support sustainable tourism, and boost local economies. Future research should explore policy interventions and community-driven approaches for safer, inclusive spaces.

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Chapter 23

Machine Learning Predictions of Stock Market Pattern Using Econophysics Approach

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ABSTRACT

A financial market collapse is the failure of a financial organisation, whereas a stock market crash is usually characterised as a sudden, large decrease in the price of stocks or stock market indexes. A speculative bubble, in which prices increase unreasonably before overvaluation causes a fall, may set this off. A stock market collapse is specifically caused by the panic that hits the market as a result of an excessive number of sell orders executed at once. According to Econophysics, interrelated behaviours and newly forming patterns in the market system are what propel market crashes, which are seen as a component of a bigger cycle of stability and instability. This research outlines the study of stock market patterns using the Econophysics approach. There are various techniques for identifying and observing the stock market patterns, one of the techniques is to use Python programming to evaluate and possibly forecast stock market behaviour through predictive modelling, combining both machine learning and Econophysics insights. Hence, this research will be using Monte Carlo Simulation and identify which machine learning algorithm is suitable for predicting stock market patterns. By leveraging machine learning algorithms, such as Long Short-Term Memory (LSTM), the predictions generated closely follow the actual stock price movements for Inari Amertron Berhad. The predicted stock prices correctly reflect whether the market is moving upward or downward and they correspond with actual market trends. Furthermore, there is a strong correlation between the model's buy or sell recommendations and the actual and anticipated price trends. In conclusion, the study of Econophysics principles with Python programming and machine learning algorithms has indicates that the predictive framework is reliable and effective in capturing stock price fluctuations, enhancing decision-making for investors based on data-driven insights.

Key Words: econophysics, stock market pattern, Python, machine learning, forecast

1. INTRODUCTION

The potential of econophysics, an interdisciplinary science that combines economics and physics, to analyze intricate financial systems has drawn a lot of interest. Econophysics uses

ideas from statistical physics and complex systems theory to examine market dynamics, providing a deeper understanding of speculative bubbles, market crashes, and stock price variations than traditional economic models, which rely on statistical techniques. This field improves market forecasts and risk assessments by identifying underlying patterns in financial markets using technologies such as computational modelling, network theory, and fractal analysis.

This study integrates Long Short-Term Memory (LSTM) models and Monte Carlo simulations with Econophysics principles to enhance stock market prediction accuracy and uncover key market cycles, such as speculative bubbles and crashes. Treating the market as a complex system, it leverages Python tools like pandas, NumPy, and matplotlib for data processing and visualization. By combining machine learning with probabilistic modelling, this research provides valuable insights for traders and researchers while advancing Econophysics by bridging physics and finance for more reliable market forecasting.

2. LITERATURE REVIEW

To overcome the constraints of conventional economic models, econophysics merges physics-based methods with financial market analysis. It developed during the second half of the 20th century and uses statistical physics, complex systems theory, and mathematical modelling to study market behaviour such as trends, trading volumes, and price fluctuations. Statistical techniques such as time series analysis, network theory, and fractal analysis are used by Econophysicists to study vast datasets of financial data. While evidence usually refutes this assumption, many stock market models rely on Gaussian statistics (Turcaş et al., 2022). Nonlinear and interrelated behaviour of economic systems are also studied using econophysics, which shows how small interactions can lead to extreme events like crashes. Stock prices are driven by investor expectations which are buying when a stock is undervalued and selling when it's overvalued. Such interaction defines the price dynamics, making investor forecasting a key issue in financial economics. Various tools, like chart patterns, are used by traders to identify trends and make well-informed decisions.

Monte Carlo method is a mathematical technique that uses random sampling to estimate probabilities in uncertain processes. It allows for the estimation of risk and supports informed decision-making across various field, including business, artificial intelligence, engineering, and stock prices. It provides valuable insights into complicated systems through uncertainty modelling and multiple simulations. It predicts the changes in asset prices through mimicking the stochastic processes, such as Geometric Brownian Motion, similar to particle movements in physics (Khamnei et al., 2023). This makes it relevant for quantifying investment risk. Python completes the process using libraries like 'numpy', 'scipy', and 'matplotlib', facilitating economical simulation, finance automation, and risk analysis relating physics and finance under Econophysics.

3. METHODOLOGY

The simulation procedure involves developing a machine learning model using Monte Carlo simulations and Python. The dataset of Inari Amertron Berhad (INARI), obtained from Yahoo Finance, is used throughout the process. Data preprocessing such as cleaning, normalization, and feature engineering is applied to ensure quality and consistency. An LSTM model, built

with TensorFlow and Keras, is selected for its effectiveness in forecasting stock prices. The model is trained on 80% of the data and tested on the remaining 20%, adjusting parameters to improve accuracy. Results are visualized using Matplotlib and Plotly, while Streamlit adds interactivity for real-time data visualization. The experimental flowchart outlines the overall process clearly.

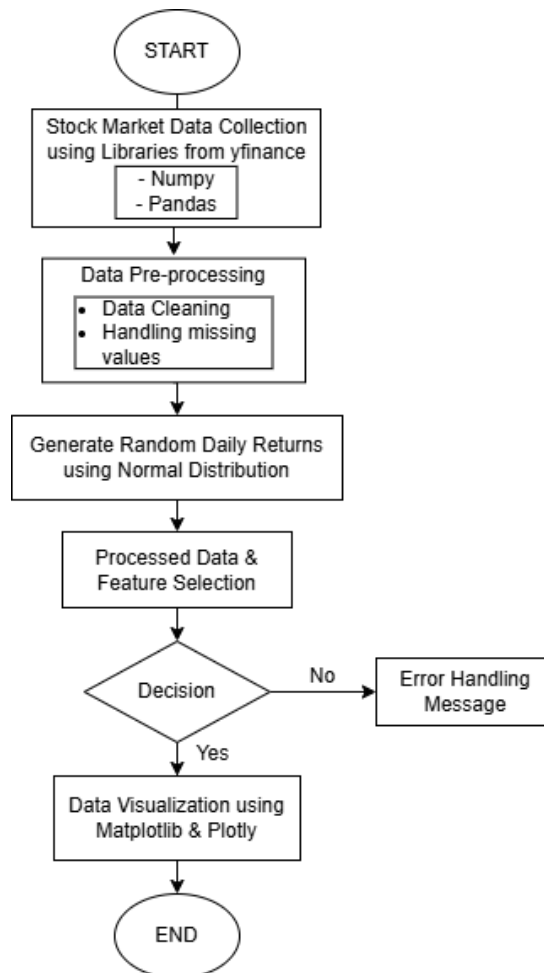


Figure 1: Project Flowchart

4. RESULTS & DISCUSSION

The simulation results are shown in the graph from matplotlib below, demonstrating several lines that demonstrate several probable stock price patterns over time of Inari Amertron Berhad. Each line in the graph signifies a potential scenario for the stock price, with the distribution of outcomes serving as an indicator of risk in the forecasts.

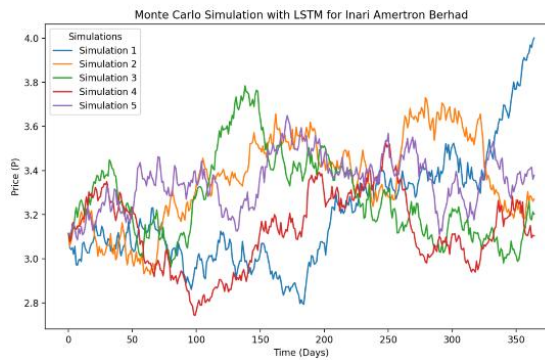


Figure 2: Monte Carlo Simulation for INARI

After analyzing the comparison graphs, the next phase in implementing the LSTM model for future stock price predictions starting September 2024. Predictions will cover 14, 30, 60 days, and beyond, offering insights into decision-making and financial planning using past data and learned parameters. Future analysis of the results of predictions will be shown in figure 4, figure 5, and figure 6 below.

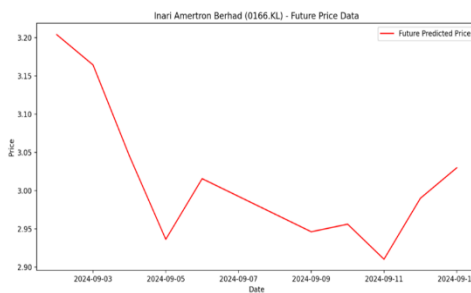


Figure 3: Graph of Analysis for 14 Days

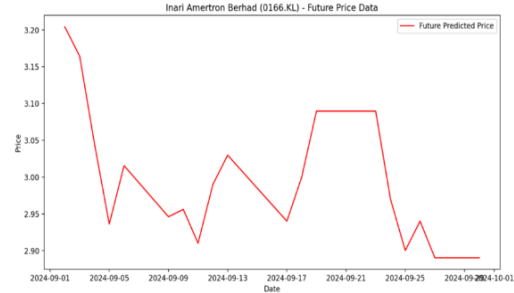


Figure 4: Graph of Analysis for 30 Days

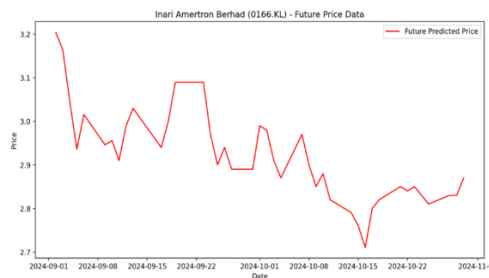


Figure 5: Graph of Analysis for 60 Days

The final phase involves integrating all observed data into an interactive dashboard using Streamlit, a user-friendly Python library for data visualization. The dashboard features an intuitive interface with a sidebar (Figure 6) where users can input criteria such as Stock Ticker, Company Name, and date ranges. Users can also adjust Time Intervals, Iterations, and Future Predicted Days via sliders to customize their stock market analysis.



Figure 6: Pre-Simulation on Streamlit

5. CONCLUSION AND RECOMMENDATIONS

This study successfully achieved its objectives by applying Econophysics and machine learning to analyze stock market patterns. By combining statistical physics with data-driven models like Monte Carlo simulations and LSTM networks, it provided valuable insights into the complex and unpredictable nature of financial markets. The interdisciplinary approach proved effective in identifying trends, bubbles, and crashes, with LSTM emerging as the most accurate model for stock prediction, supporting better decision-making in uncertain market conditions.

Recommendations:

1. **Real-time Monitoring:** Implement an API to integrate live-stock market data for instant predictions and patterns updates.
2. **Expanded Dataset & Timeframe:** Improve accuracy by incorporating longer historical data, diverse industries, and external factors like economic cycles and geopolitical events.
3. **Improved Data Visualization:** Develop an integrated interface displaying Monte Carlo simulations, predictions, and recommendations for a more intuitive user experience.

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Chapter 24

Enhancing Pupils' Vocabulary Acquisition Through the Use of BrightEnglish

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ABSTRACT

Acquiring a foreign language requires a strong foundation in vocabulary. Without mastering this fundamental element, learners often face difficulties in understanding and using the language effectively. This issue is commonly observed among non-native English speakers in Malaysia, where English is taught as a second language. Many elementary school students struggle to speak and write proficiently in English. During English lessons, they often revert to using their mother tongue, Malay, which highlights the challenges they face. When asked to write basic words, many are unable to spell them correctly. To address this issue, teachers have implemented various interventions, one of which is the development of BrightEnglish. BrightEnglish introduces a new approach to teaching vocabulary to primary school students. The website aligns with the goal of integrating technology into teaching and learning. It offers a variety of interactive activities, including educational games, to help students acquire vocabulary in an engaging way. Additionally, the platform introduces students to modern methods of learning and knowledge acquisition. What makes BrightEnglish unique is its adaptable content, which can be tailored to meet the diverse needs of students and teachers across different regions, cultures, and subjects—not just English. Moreover, it serves as a tool for teachers to explore and implement technology-enhanced learning in their classrooms. In doing so, BrightEnglish supports both teachers and students in their journey toward improved language acquisition.

Key Words: Vocabulary, BrightEnglish, Technology, Interactive Materials, Online Learning

1. INTRODUCTION

Vocabulary forms the foundation of language learning. A lack of sufficient vocabulary knowledge presents a significant obstacle for most students, particularly those learning a second language (L2). To effectively acquire a language, learners must develop four key skills: listening, reading, speaking, and writing—all of which are heavily influenced by vocabulary proficiency. Despite its importance, many students find vocabulary acquisition to

be one of the most challenging aspects of language learning. Therefore, it is essential to explore students' vocabulary knowledge and introduce effective methods for vocabulary instruction. Well-designed learning systems can simplify vocabulary acquisition and enhance overall L2 learning. Vocabulary instruction supports students in understanding and communicating in English, which remains a demanding task without a solid lexical foundation.

In Malaysia, the nation must acquire and learn English as a second language starting from the pre-school level. In fact, vocabulary is one of the core elements of language aptitude and reflects how well listeners listen, speak, read and write (Kunnu, Uiphand & Sukwises, 2016). The importance of teaching English as a second language had been given emphasis in Malaysia so that pupils who are able to read and understand different English texts for information and enjoyment can be produced.

2. LITERATURE REVIEW

2.1 Teaching and Learning Vocabulary

Vocabulary plays a vital role in English language learning. It serves as the foundation that connects the four essential skills: listening, speaking, reading, and writing. To achieve a high level of proficiency, pupils need to acquire a sufficient range of vocabulary and understand how to use it effectively. However, equipping primary pupils with an adequate vocabulary remains a challenging task for English language teachers, despite the use of various teaching strategies designed to support vocabulary learning (Yunus et al., 2020).

According to Indriyani and Sugirin (2019), vocabulary is imperative to be acquired by the learners. Recent studies in second and foreign language acquisition emphasised that non-native speakers need a good foundation of vocabulary knowledge in order to become successful English language users (Viera, 2016). Within the Malaysian context, the teaching and learning process of vocabulary in English language begins as early as Primary 1 and onwards to Primary 6 (Ministry of Education, 2017).

3. METHODOLOGY

3.1 Innovation model

The ADDIE model was used in the development of the website. It is an Instructional Design model that has withstood the test of time and use. (University of Washington, 2024). During the analysis phase, the developer identified a key problem: pupils in primary school were struggling to learn vocabulary effectively. In response, the developer proposed the creation of a website specifically designed to address this issue, while also aligning with the educational digitalization policy. In the design and development phases, the website was created using Google Sites as the platform. Educational materials were sourced from various reliable resources that the developer believed would support vocabulary acquisition. Interactive games, for instance, were incorporated using Wordwall—an online tool for creating engaging educational activities. In the implementation phase, the innovation was tested with 30 pupils over a period of three weeks. During this period, the developer encountered several challenges related to the use of the innovations. Prompt actions were taken to address and resolve these issues to ensure the effectiveness of the implementation. Finally, in the

evaluation phase, a Google Form was distributed to the participants to gather feedback on their experience. The results and insights gained from this feedback will be discussed in the following section.

4. RESULTS & DISCUSSION

Following the implementation of the BrightEnglish programme over a period of three weeks, positive outcomes were observed (refer to Figure 1). Pupils demonstrated improved understanding of basic vocabulary and were able to recall previously taught content effectively. Additionally, the programme enhanced their ability to spell vocabulary items accurately. This innovation has proven effective in helping pupils acquire a solid foundation in language learning while engaging in enjoyable activities. Moreover, it has successfully met the objective of integrating digital technology into the learning process.

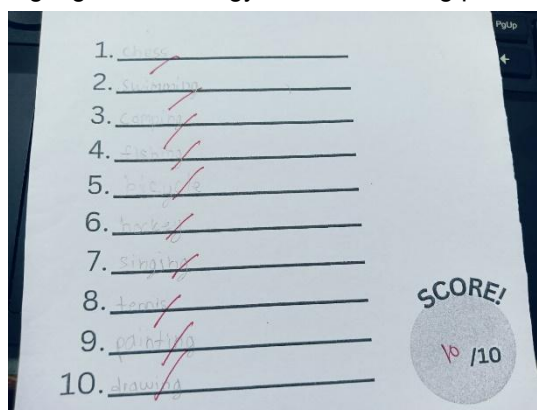


Figure 9: Vocabulary exercise

Figure 2 presents the data collected from the participants. The findings indicate that pupils found the activities provided on the website to be interesting. Out of 30 participants, nearly half responded that the website's activities were engaging. This suggests that the materials used were effective in capturing the pupils' attention. Furthermore, the results demonstrate that this innovation contributes to making lessons more engaging and enjoyable.

How do you think about the activities in the website

 Copy chart

23 responses

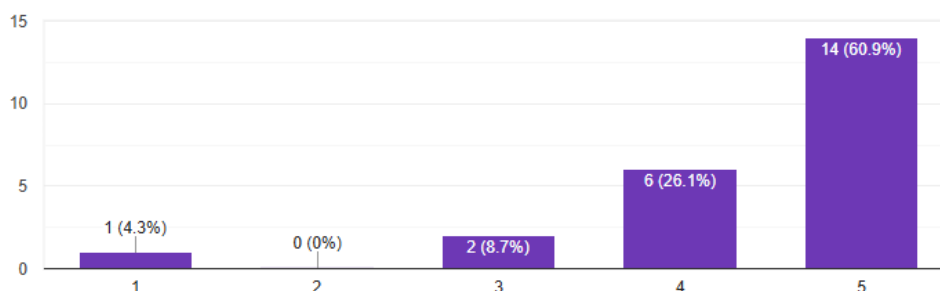


Figure 2: Pupils' response after using the BrightEnglish.

5. CONCLUSION & RECOMMENDATION

In conclusion, the innovation has proven effective in helping pupils learn vocabulary. The website demonstrates strong potential for enhancing lesson enjoyment for both students and teachers. For educators interested in using this innovation, it is highly recommended that they tailor the website to suit both their teaching objectives and their pupils' specific needs.

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Chapter 25

Disposable 3D-Printed Flow Cell Biosensor for Pathogenic Escherichia Coli Bacteria Detection

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ABSTRACT

This research seeks to develop an innovative 3D-printed biosensor for the rapid and accurate detection of Escherichia coli (E. coli) bacteria in water samples. The proposed biosensor will incorporate a flow cell design, which allows continuous monitoring and efficient detection of E. coli in real-time. The sensor will be fabricated using conductive polymer-based materials integrated with specific biological recognition elements to ensure high sensitivity and specificity. The 3D printing technology will be utilized to create a precise and reproducible flow cell structure, optimizing the sensor's functionality and scalability. The research will proceed through several key phases: designing and simulating the flow cell structure, selecting and functionalizing the sensing materials, fabricating the biosensor using 3D printing techniques, and conducting extensive testing with water samples containing various concentrations of E. coli. This research will establish a foundation for future advancements in portable and effective biosensing devices for early detection of bacterial contamination.

Key Words: Escherichia Coli; Biosensor; Flow Cell; 3D printing.

1. INTRODUCTION

Escherichia coli (E. coli) is a diverse group of bacteria commonly found in the intestines of humans and warm-blooded animals. While most E. coli strains are harmless and play a crucial

role in maintaining intestinal health, some strains can cause severe food poisoning, urinary tract infections, and even life-threatening conditions such as hemolytic uremic syndrome (HUS). These pathogenic strains are a significant public health concern, particularly in environments where food and water contamination are prevalent.

2. LITERATURE REVIEW

Flow cell biosensors based on electrochemical structure have emerged as a superior design for detecting bacterial contamination. The flow cell structure offers several advantages that include continuous monitoring, enhanced sensitivity, improved response time, and reduced fouling (Stilman et al., 2022). The flow cell design allows for the continuous flow of samples through the sensor, enabling real-time monitoring and immediate detection of contaminants.

This research will leverage 3D printing technology in biosensor production. 3D printing allows for the precise and reproducible creation of complex sensor structures that would be challenging to produce using traditional manufacturing methods (Siller et al., 2020). Key benefits of using 3D printing for biosensor production include customization, scalability, precision, and material versatility. In this case, 3D printing enables the design and production of biosensors tailored to specific applications and requirements.

3. METHODOLOGY

3.1. Design and selection of sensing materials

The initial phase of the research involves the conceptualization and optimization of the 3D-printed flow cell biosensor's design using computer-aided design (CAD) software Figure 1. The second phase focuses on the selection and functionalization of conductive polymer-based materials to be used in the biosensor. The process begins by identifying and testing various conductive polymers suitable for 3D printing and biosensing applications.

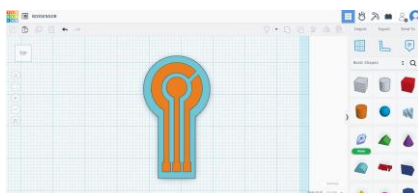


Figure 1: Schematic of the 3D-printed flow cell biosensor's design

3.2. Setup for the cyclic voltammetry (CV) testing

This phase began with the preparation of the cyclic voltammetry (CV) setup to evaluate its performance on the water samples Figure 2. The Analog Device ADALM1000 was used to demonstrate the relationship between current, voltage, and impedance (including resistance, inductance, and capacitance).

The CV setup included three different electrode materials: 1) platinum (Pt) as the counter electrode, which was connected to the GND of the ADALM1000, 2) graphite (Gr) as the working electrode, which was connected to the CHA of the ADALM1000, and 3) silver

chloride (AgCl) as the reference electrode, which was connected to the CHB of the ADALM1000. For the preparation of the water sample used to systematically evaluate the CV's performance, the experiment utilized two solutions consisting of: 1) 40 mL of 3M KCl combined with 3 mL of 0.1M KCl + 0.5 mg/mL of NiTsPc, and 2) 40 mL of 3M KCl combined with 6 mL of 0.1M KCl + 0.5 mg/mL of NiTsPc.



Figure 2: Setup for the cyclic voltammetry (CV) testing

3.3. Setup for the 3D-printed flow cell biosensor testing

The experiment continued with the preparation of the 3D-printed flow cell biosensor setup to evaluate its performance on the water samples Figure 3. In this phase, only the CV component was replaced with the biosensor, while the other devices remained the same for data evaluation.

The biosensor also contained three different electrodes: 1) the counter electrode was connected to the GND of the ADALM1000, 2) the working electrode was connected to the CHA of the ADALM1000, and 3) the reference electrode was connected to the CHB of the ADALM1000. The biosensor was tested by before and after applying a solution of 0.1M KCl + 0.5 mg/mL of NiTsPc onto its conductive surface to obtain the readings.

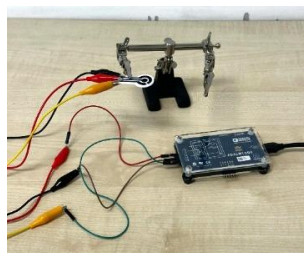


Figure 3: Setup for the 3D-printed flow cell biosensor testing

4. RESULTS & DISCUSSION

4.1. Fabrication of the biosensor using 3D printing

The research is centered on the actual fabrication of the 3D-printed flow cell biosensor using advanced 3D printing techniques Figure 4. High-resolution Bambu Lab A1 mini 3D printers will be employed to fabricate the optimized flow cell structure, ensuring precise replication of the design developed in the first phase.



Figure 4: (a) The advanced 3D printing techniques, and (b) The actual fabrication of the 3D-printed flow cell biosensor

4.2. Testing on the cyclic voltammetry (CV)

The CV graph illustrated the response of how the current changed as the voltage was scanned in both the forward and reverse directions Figure 5. The solution for this experiment was prepared using 40 mL of 3M KCl combined with 3 mL of 0.1M KCl + 0.5 mg/mL of NiTsPc. It showed that there were no clear peaks of oxidation and reduction available because the electrolyte solution might be insufficient at low concentration. The current (A) ranged from approximately -0.035 to 0.04 A, while the voltage (V) varied between 0 and 3 V.

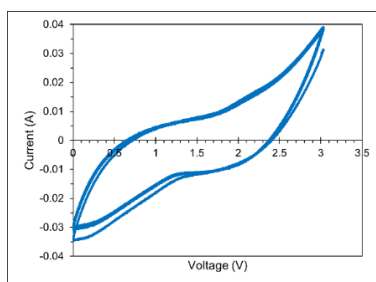


Figure 5: CV's graph of 40 mL of 3M KCl with 3 mL of 0.1M KCl + 0.5 mg/mL of NiTsPc

This part showed the typical shape with an oxidation (anodic) and reduction (cathodic) peak illustrating the electroactivity of the system Figure 6. Red lines showed the slope of different regions with response to the change in the current, and green arrows showed the voltage readings for oxidation was 2.2 V and reduction was 0.9 V. The solution for this experiment was prepared with 40 mL of 3M KCl with 6 mL of 0.1M KCl + 0.5 mg/mL of NiTsPc. The current (A) ranged from approximately -0.027 to 0.03 A, while the voltage (V) varied between 0 and 3 V.

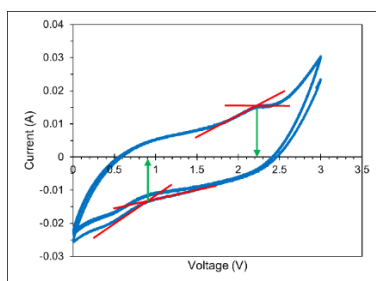


Figure 6: CV's graph of 40 mL of 3M KCl with 6 mL of 0.1M KCl + 0.5 mg/mL of NiTsPc

4.3. Testing on the 3D-printed flow cell biosensor

As stated in the method, the 3D-printed flow cell biosensor was tested before and after the electrolyte solution was applied. Figure 7 displayed the graph obtained when the biosensor was tested without any solution. The result showed that the voltage (V) ranged from 0 to 0.5 V, remaining nearly constant at Channel B across each cycle.



Figure 7: Biosensor's graph without any solution

Next, the solution for this experiment was prepared using 0.1M KCl + 0.5 mg/mL of NiTsPc, then applied to the biosensor to obtain the graph Figure 8. The results showed that the voltage (V) ranged from 0 to 1.4 V. A clear change was detected as the peaks increased, indicating that the biosensor exhibited conductive capability in detecting the solution.



Figure 8: Biosensor's graph with the solution of 0.1M KCl + 0.5 mg/mL of NiTsPc

5. CONCLUSION & RECOMMENDATION

It could be concluded that the fabrication of the 3D-printed flow cell biosensor using advanced 3D printing techniques achieved early success, as it was a low-cost, disposable, biodegradable, and mass-producible alternative to conventional methods.

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Chapter 26

FRESHOLIFT: Smart Vertical Shelf System for People with Disabilities

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ABSTRACT

FRESHOLIFT is an inclusive smart vertical shelf system designed to revolutionize fresh food storage in supermarkets. It addresses three significant challenges: accessibility for people with disabilities, food freshness, and environmental sustainability. With a vertical lift mechanism and AI-driven inventory management, FRESHOLIFT uses temperature, humidity, and gas sensors to monitor and maintain optimal freshness while reducing food waste through FIFO (First-In-First-Out) usage. Its user-friendly interface includes voice commands, screen readers, and Braille support, making it accessible to the elderly and people with mobility or visual impairments. The design also incorporates modular, energy-efficient components and supports clean energy options like solar power. Through its smart, inclusive, and sustainable features, FRESHOLIFT promotes healthier food practices, empowers independent shopping experiences, and contributes to responsible retail innovations.

Key Words: smart shelf, accessibility, food freshness, AI inventory, disabilities

1. INTRODUCTION

Ensuring the freshness of vegetables is vital for maintaining their nutritional value and minimizing household food waste. Post-harvest, vegetables rapidly lose moisture, texture, and essential nutrients. Proper storage conditions, specifically regulated temperature, humidity, and airflow, can significantly delay spoilage, preserving flavor and nutritional content and reducing food waste and associated costs (Albrecht, 2016). Beyond freshness, accessibility in food storage systems is crucial, especially in public retail environments like supermarkets. Traditional storage designs often overlook the needs of individuals with disabilities, presenting barriers such as high shelves, narrow aisles, and a lack of assistive technologies. Recent studies highlight that 88% of consumers believe that accessible retail

environments are the hallmark of inclusivity, yet many retailers fall short in implementing necessary accommodations (SLD, 2023).

Innovative technologies like AI-driven inventory systems and automated mechanisms can improve food storage and enhance the shopping experience. AI applications are being developed to transform customer service for individuals with disabilities, ensuring broader accessibility and inclusivity in retail settings (Forbes, 2024). Implementing such innovative, inclusive systems in supermarkets caters to a wider customer base and aligns with corporate social responsibility goals.

2. PROBLEM STATEMENT

One of the most pressing issues in modern supermarkets is the lack of physical accessibility in food storage systems, particularly for individuals with disabilities. Many chiller cabinets and shelving units are designed without consideration for wheelchair users or those with limited mobility, creating physical barriers to access. This issue has been raised by advocacy groups and shoppers alike, with several supermarket chains facing criticism for introducing inaccessible fridge and freezer systems (Disability News Service, 2024). Without accessible designs like lower shelves and easy-to-open doors, supermarkets may exclude a key segment of their customers and neglect universal design principles.

Inefficient management of perishable inventory contributes to food waste and reduced availability. Traditional shelves lack monitoring tools for tracking freshness and demand, leading to overstocking and expired items due to poor rotation. Recent developments in AI-driven retail solutions have shown promise in addressing these issues by enabling real-time inventory tracking, demand prediction, and automated FIFO (first-in, first-out) management strategies (Culinary Coverage, 2025). However, such systems have yet to be widely adopted in most supermarkets, particularly low-resource or high-traffic settings.

Retail staff often lack training and resources to effectively support customers with diverse abilities, leading to feelings of exclusion. Enhancing service through accessibility-oriented staff training and integrating assistive technologies, such as voice-guided systems and braille labeling, can significantly improve the customer experience (Joy Delivery UK, 2025). Supermarkets must acknowledge that inclusivity is a social obligation and a business opportunity to serve all customers with equity and dignity. With increasing demands for sustainable, accessible, and innovative storage, there is a clear need for FRESHOLIFT.

3. OBJECTIVES

3.1 To Enhance Accessibility and Independent Use for Disabled Individuals in Supermarkets

To create an inclusive food storage system enabling independent, dignified shopping for people with disabilities through accessible design and assistive features.

3.2 To Improve Freshness Monitoring and Minimize Perishable Food Waste

Optimize storage and reduce waste using AI-driven climate control and FIFO inventory in modular trays.

3.3 To Promote Energy-Efficient and Environmentally Sustainable Storage Practices

To support sustainability through energy-saving components, recyclable materials, and alignment with SDGs 7 and 12.

4. MATERIALS/METHODS

4.1 Product Description

FRESHOLIFT is an innovative vertical shelf system that elevates fresh food storage in supermarkets with a lift-and-slide mechanism, improving accessibility and maximizing floor space. It reduces messes, enhances food rotation, and delivers fresh produce at an easily reachable height.

4.1.1 The System

FRESHOLIFT's innovative technology employs robotic tray retrieval elements similar to those used for car lifts in parking structures. The robotic system consists of vertical rails with stepper motors that use a horizontal slider to extract chosen shelves from their storage positions before moving them to a usable height.

4.1.2 Multi-Sensing Smart Module (VEG Guard)

The innovative sensor system controls vending machines' temperatures and moisture levels while monitoring freshness outcomes. The product has integrated three sensors into its small format. The humidity sensor detects ideal moisture conditions for leafy vegetables' proper growth. The low-power microcontroller analyzes all collected data for cloud system or machine controller updates.

4.1.3 The Controller

The interface features shatterproof capacitive glass on its touchscreen and rubberized physical buttons that maintain good tactility. Interface features support sensory needs, including voice guidance, visual contrast settings, and Braille labels.

4.2 The Operation Process

The FRESHOLIFT operation involves six key steps. Step 1: Easy Access – The user approaches the machine, which is designed to accommodate wheelchair users, with the interface positioned at a comfortable height. Step 2: Product Selection – Items are selected using a touchscreen or voice-guided controls, supporting those with visual or mobility

impairments. Step 3: Payment – The user completes the purchase through various payment options, initiating the retrieval process. Step 4: Shelf Retrieval – The system automatically rotates and retrieves the selected tray, reducing physical effort. Step 5: Item Delivery – The tray is delivered at an accessible height for easy collection. Step 6: Collection and Exit – The user collects the item and exits, completing a smooth, self-service shopping experience.

5. NOVELTY

FRESHOLIFT has a built-in cooling system with independently climate-controlled compartments and high-precision sensors to monitor freshness. It features a low-reach tray delivery system for accessibility, making it easy for the elderly and individuals with disabilities to use. Voice-guided interaction and extensive touchscreen controls enhance the customer experience.

6. FEEDBACK FROM COMMUNITY

Survey findings reveal that 70% of respondents face moderate to high difficulty accessing fresh food independently, mainly due to layout and shelf height. A significant 80% believe supermarkets lack inclusive design for people with disabilities. Notably, 76.7% strongly agree that FRESHOLIFT would support independent shopping for the disabled. An overwhelming 96.7% recognize the importance of inclusive technologies like FRESHOLIFT. Additionally, 70% feel it would enhance their shopping experience, highlighting its broad appeal and usefulness.

7. BENEFITS TO THE COMMUNITY

Installing a FRESHOLIFT raises awareness about accessibility for disabled individuals, promoting empathy and social responsibility. It enhances convenience and independence, allowing users to shop at their own pace. Including automatic vegetable vending machines also improves access to healthy produce, removing barriers in traditional grocery stores.

8. COMMERCIALIZATION POTENTIAL

FRESHOLIFT benefits supermarkets by enabling intelligent climate control and real-time freshness monitoring, minimizing loss and enhancing efficiency. In healthcare and assisted living, its accessible design helps people with disabilities store and prepare fresh foods independently, promoting dignity and better nutrition.

9. CONCLUSION

FRESHOLIFT is an eco-friendly shelving system that enhances fresh food storage in supermarkets. Designed with AI technology, it improves accessibility for the elderly and individuals with disabilities. This system reduces waste and promotes a healthier lifestyle.

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Chapter 27

AI-Nspector: A Fast and Seamless Inspection Drone System

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ABSTRACT

The exponential growth of global trade has placed immense pressure on logistics operations, particularly in cargo inspection, where traditional methods fall short in speed, accuracy, and safety. AI-Nspector is an innovative drone-based inspection system designed to revolutionize cargo processing by integrating artificial intelligence, automation, and advanced sensors. This system addresses significant inefficiencies in manual inspection by automating the process, significantly reducing human error, and enhancing the detection of hidden threats such as contraband and counterfeit goods. With high-resolution, thermal, and LiDAR cameras, AI-Nspector performs real-time cargo scanning, transmitting data to an AI-powered dashboard that enables inspectors to make informed decisions. Beyond efficiency, the system enhances occupational safety by minimizing the need for personnel to enter hazardous environments. The inspection process is streamlined through a step-by-step protocol from drone deployment and real-time monitoring to barcode generation and fast-track customs clearance. AI-Nspector's uniqueness lies in its contactless operation, real-time analytics, and seamless integration into existing logistics workflows, collectively improving operational throughput, inventory accuracy, and cargo security. With significant commercialization potential, the system promises reduced operational costs, faster supply chain turnaround, and stronger regulatory compliance. Moreover, its benefits extend to communities by lowering product prices, improving workplace safety, and supporting legal trade through the early detection of illicit goods. As a transformative tool for modern logistics, AI-Nspector exemplifies how AI and robotics can improve global cargo inspection standards.

Key Words: Artificial Intelligence, Cargo Inspection, Drone Technology, Logistics Automation, Supply Chain Security

1. INTRODUCTION

In today's fast-moving trade industry, cargo inspection has become more challenging than ever. With thousands of containers passing through ports daily, manually checking them is slow, complex, and sometimes unsafe for workers. Human inspections are also prone to mistakes, delays, and missed threats like smuggled goods or hazardous materials. As global trade continues to grow, there is a strong need for smarter and faster inspection systems (Muscat Cargo, 2025; GAO, 2022). Artificial intelligence (AI) plays a key role in solving these problems. AI systems can quickly scan cargo using cameras, sensors, and data analysis to spot hidden compartments, dangerous goods, or fake products. These tools work much faster than people and with greater accuracy, helping customs and security officers make better decisions in less time (Arvist.ai, 2025; OpenTools.ai, 2025). This speeds up the movement of goods and helps prevent security threats.

AI inspection also makes the job safer for workers. Instead of physically entering dark, hot, or dangerous cargo areas, AI-powered machines can inspect everything from the outside. This reduces the risk of injury and improves working conditions (Averroes.ai, 2024). AI is helping the trade industry move forward by making inspections quicker, smarter, and safer. AI-Inspector is a solution designed for quick and efficient inspections. It is not just a new product but a catalyst for transformation in the logistics sector. It showcases how intelligent automation can revitalize outdated systems, providing smarter, faster, and more reliable inspection results for ports, warehouses, and customs authorities.

2. PROBLEM STATEMENT

As international trade grows, the logistics industry faces increasing pressure to be faster, safer, and more resilient. However, cargo inspection remains heavily dependent on manual labor. Human-led inspections are labor-intensive, slow, and prone to fatigue, leading to errors, security lapses, and operational delays (Muscat Cargo, 2025). Ports like Port Klang handle millions of containers each year, and there will be over 14 million TEUs in 2023 alone, making it impossible to rely solely on manual checks (Malay Mail, 2024). These outdated processes create backlogs, increase costs, and slow down the supply chain.

Furthermore, traditional methods often fail to detect weapons, narcotics, and counterfeit goods smuggling. In some cases, contraband is only discovered by chance or through anonymous tips, not systematic inspection (GAO, 2022). Such failures seriously threaten national security, economic integrity, and public safety. Manual inspections also endanger personnel, exposing them to hazardous materials and dangerous environments. These safety concerns highlight the need for automation in inspection procedures (Averroes.ai, 2024). Despite significant advancements in other industries, many logistics hubs still lag in adopting automation and AI. This technology gap prevents them from achieving peak operational efficiency (Arvist.ai, 2025).

3. OBJECTIVES

3.1 To Solve Inefficiencies in Manual Inspection

Automate cargo inspections to reduce delays at ports and checkpoints, increasing efficiency without sacrificing accuracy.

3.2 To Improve Detection of Hidden Threats and Reduce Human Error

Manual inspections often miss critical issues due to limited visibility and fatigue, so this system uses AI and advanced sensors for a more accurate approach.

3.3 To Make Inspections Safer for Workers

Inspecting containers remotely reduces risks for workers in hazardous conditions.

4. MATERIALS/METHODS

4.1 Product Description

AI-Nspector is an AI-driven drone system that enhances cargo inspections with high-resolution cameras and sensors, quickly identifying smuggled goods and shipment errors in real time. It improves processing speed and supply chain visibility, ensuring safer and more efficient cargo management.



Figure 1: Image of the AI-Nspector

4.2 Step-by-Step AI Inspection Process

The AI-Nspector inspection process involves six key steps. Step 1: Truck Arrival – The process starts when a cargo truck arrives at the warehouse for pre-export inspection. Step 2: Drone Scans the Truck – The AI-powered drone automatically launches and scans the truck inside and out using high-resolution, thermal, and LiDAR cameras, navigating safely around obstacles. Step 3: Live Monitoring – A human inspector monitors a live dashboard displaying real-time data, where the system highlights anomalies such as incorrect cargo or suspicious items. Step 4: Follow-Up Check – The inspector then investigates any flagged areas and removes illegal, counterfeit, or unlisted goods if found. Step 5: Inspection Barcode Created – Once cleared, a digital barcode confirming the completed inspection is generated and attached to the truck. Step 6: Fast Customs Clearance – At customs, officers scan the barcode

for instant access to inspection results and shipment details, ensuring quick and efficient clearance.

5. NOVELTY

AI-Nspector is an automated drone-based cargo inspection system that uses high-resolution, thermal, and LiDAR cameras to scan trucks in real time. It collects detailed data, reads barcodes, and detects hidden issues, including smuggled goods and safety risks. Its unique AI dashboard analyzes data instantly, improving inspection speed and accuracy. This innovative solution enhances safety and security in cargo inspections.

6. COMMERCIALIZATION POTENTIAL

The AI-powered drone system has significant potential for commercialization in the logistics and freight industry. Its ability to autonomously scan and inspect cargo enhances efficiency by reducing manual checks, minimizing errors in shipment verification, and speeding up inspections (Hofman, 2024; Srivastava, 2025). Real-time AI detects counterfeit goods and shipping discrepancies, streamlining warehouse operations with instant data access for quicker decisions. Integrating AI-Nspector with logistics enhances turnaround times, inventory accuracy, and supply chain visibility, while reducing costs for freight forwarders. Its adaptability across different environments positions AI-Nspector as a game-changer, addressing efficiency, security, and sustainability concerns (Pymnts, 2023). Overall, AI-Nspector is advantageous for logistics companies.

7. BENEFIT TO COMMUNITY

AI-Nspector enhances cargo inspections with AI-powered drones and real-time data analysis, improving safety and job satisfaction for inspection staff. It speeds up processing in ports like Port Klang, reducing business delays and costs. Additionally, it strengthens security by detecting smuggled or counterfeit goods early, benefiting lawful trade practices.

8. FEEDBACK FROM COMMUNITY

Survey findings reveal strong support for AI-Nspector as a solution to improve cargo inspection. About 60% of respondents strongly agreed that manual inspections are slow and error-prone, emphasizing the need for smarter, automated systems. Most participants (53.3% strongly agreed, 33.3% agreed) viewed drone technology as vital for boosting inspection accuracy and efficiency. Additionally, 56.7% highlighted the system's ability to enhance worker safety by reducing exposure to hazardous conditions. 53.3% also supported drones for speeding up the inspection process. Overall, 70% strongly believed that innovations like AI-Nspector can streamline operations and bring broader community benefits.

9. CONCLUSION

AI-Nspector revolutionizes logistics by enhancing inspection speed and accuracy through AI and automation, improving worker safety and supply chain security. Its implementation addresses key weaknesses in manual processes, making it vital for the global trade ecosystem.

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Chapter 28

Tra-Learn: From Zero to Trade Hero

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ABSTRACT

Tra-Learn is a mobile learning app designed to transform how secondary school students (ages 15 - 17) engage with trade and commerce. Moving beyond the limitations of traditional textbook learning, Tra-Learn introduces an interactive, game-based environment that makes complex trade concepts more accessible, engaging, and practical. The app integrates dynamic features like quizzes, bite-sized notes, current global trade news, and business simulation games to encourage active learning and critical thinking. These elements help bridge the gap between theoretical knowledge and real-world application, making the learning experience meaningful and enjoyable. One of Tra-Learn's key strengths lies in its accessibility. With offline functionality, students can continue learning anytime, anywhere, without constant internet access. This feature ensures inclusive education, especially for areas with limited connectivity. Tra-Learn also offers a clean, intuitive interface that allows students to navigate effortlessly through content tailored to their learning pace and preferences. The personalized learning pathways support a more effective and engaging educational journey, fostering greater independence and curiosity. Tra-Learn aims to nurture economically informed, globally aware students who are prepared to think critically about the world by reimagining how trade and commerce are taught. It's not just an app; it's a step towards cultivating a new generation of learners ready to thrive in a global economy.

Key Words: trade education, mobile learning, gamification, secondary education, interactive app

1. INTRODUCTION

Trade has always been essential for economic development and cultural exchange, from ancient caravans to modern cargo ships. It involves more than just transactions; it encompasses systems, regulations, relationships, and innovations facilitating trade (Rudge, 2024). In contemporary economies, trade significantly boosts GDP, employment, and technological advancement (Heakal, 2025).

Recognizing the benefits of trade is crucial, as it drives economic growth and fosters international relationships. However, teaching this complex subject to younger learners is challenging. Traditional educational methods, such as textbooks and lectures, often disengage students and fail to link theory to real-world contexts (Feder, 2021).

With globalization changing the economic landscape, there is an urgent need for students to grasp trade concepts. Interactive digital tools can enhance engagement and understanding (Ryhus, 2024). Tra-Learn was designed to meet this need, providing a visual and interactive platform for teaching trade, aligning with modern digital pedagogy trends (Crudu, 2024).

2. PROBLEM STATEMENT

Traditional teaching methods in trade education often alienate high school students, especially those who struggle to connect textbook theories to real-world scenarios. Educational research consistently shows that learners retain more information and remain more engaged when actively involved in learning (Feder, 2021). However, most syllabuses lack experiential components that relate trade theories to practical decision-making.

Moreover, access to quality trade education is uneven. Students in under-resourced or rural areas frequently lack exposure to up-to-date and engaging content, especially in economic subjects. There is also minimal support for self-learners who seek to explore trade outside formal classroom settings. Tra-Learn addresses these gaps by offering a holistic and inclusive learning experience. It provides scenario-based simulations, real-time trade news, gamified quizzes, and editable notes, making trade education accessible, interactive, and relevant.

3. OBJECTIVES

The objectives are:

3.1 To Enhance Accessibility and Engagement in Trade Education

By making trade education interactive and accessible for students aged 15–17 through gamification and quizzes, we can encourage sustained interest in trade and commerce topics.

3.2 To Promote Active and Experiential Learning

The goal is to enable students to apply trade concepts using real-time news, interactive quizzes, and simulation games, boosting knowledge retention and critical thinking.

3.3 To Facilitate Self-Learning and Continuing Education Opportunities

Tra-Learn supports self-learning and continuing education, providing diverse resources for high school students and teachers. Its mobile accessibility enables global trade learning for all backgrounds, anytime and anywhere.

4. MATERIALS/METHODS

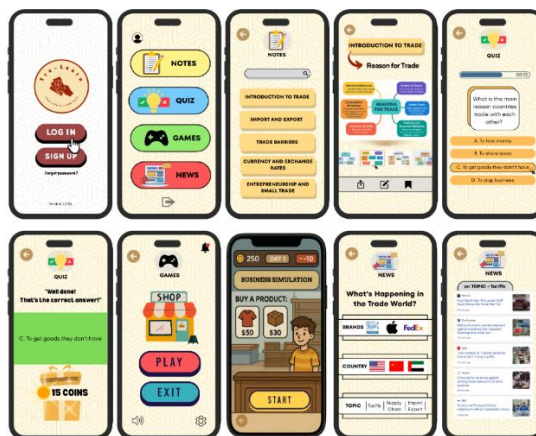


Figure 1: Tra-Learn Interfaces

Upon entering Tra-Learn, users are welcomed with a secure login and sign-up page. New users can easily register using their email or social media accounts, while returning users can quickly log in to resume their progress and explore all features seamlessly. A “forgot password” option allows fast account recovery. The “Notes” feature enhances learning by offering quick access to key ideas across various topics. Users can browse randomly or search for specific content, with instant mind maps providing clear visual overviews to aid understanding and retention. Tools like the share button (arrow icon), edit button (pencil icon), and bookmark feature let users share materials, personalize notes, highlight key points, and save lessons for easy access later. Tra-Learn also features an interactive “Quiz” section that actively engages users with time-bound quizzes on trade concepts. This gamified approach challenges users to think quickly, rewarding correct answers with coins redeemable in the “Business Simulator” games, encouraging continuous learning. Tra-Learn’s Business Simulator offers a fun, interactive way to experience real-world business challenges. Players use starter coins to build and grow virtual companies, making strategic decisions to stay profitable. With simple controls like “PLAY,” “EXIT,” and “SETTINGS,” the game sharpens critical thinking while keeping users entertained. The News feature delivers up-to-date trade insights, letting users filter by Brands, Country, or Topic for quick, targeted access to relevant issues, making it easy to stay informed without the hassle.

5. NOVELTY

Tra-Learn offers offline access to lessons and quizzes, which is ideal for students in low-connectivity areas. Its mobile-first, user-friendly design combines gamification with interactive features for an engaging learning experience. Tailored pathways focus on individual strengths and weaknesses, while real-world simulations and up-to-date business news foster a dynamic environment. This innovative platform empowers the next generation of global entrepreneurs and trade professionals.

6. COMMERCIALIZATION POTENTIAL

Tra-Learn has strong commercialization potential, aligning with entrepreneurship and trade education trends for both public and private schools. Its customizable features allow for easy updates without significant changes. With a user-friendly design and offline capabilities, it supports low-energy mobile use, bridging the digital divide among students. Thus, Tra-Learn establishes itself as a scalable, user-centric learning solution.

7. BENEFIT TO COMMUNITY

This app teaches high school students, ages 15-17, essential trade, business, and economics knowledge through easy notes, engaging quizzes, and business simulation games. It enhances their financial literacy and critical thinking while building confidence in decision-making. The app fosters interest in entrepreneurship and money management, nurturing skilled young individuals ready to contribute to their communities and future careers.

8. FEEDBACK FROM COMMUNITY

Feedback from 30 students revealed unanimous agreement on the effectiveness of learning through apps, with all respondents stating that such tools enhance study efficiency due to their interactive and user-friendly design. Over half (56.7%) strongly agreed that mobile apps improve learning accessibility, citing the ability to study anytime and anywhere as a key benefit. All participants praised the business and trade game for making complex topics more enjoyable and engaging, enhancing learning motivation. Tra-Learn's offline access feature was especially appreciated by 80% of students, as it supports consistent learning despite poor internet connectivity. Additionally, all students agreed that features like quizzes, current trade news, and concise notes help clarify trade concepts, making the subject more relatable and easier to understand.

9. CONCLUSION

Tra-Learn is an innovative app that aims to transform how students approach trade education. It focuses on making learning enjoyable, accessible, and relevant to everyday life. By leveraging technology, Tra-Learn encourages curiosity and confidence among students, preparing them for the global marketplace. Ultimately, it aims to empower young individuals to adopt the mindset of future business leaders.

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Chapter 29

Eco-S.C.O.U.T

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ABSTRACT

As the global demand for faster, safer, and greener delivery solutions grows, Eco-S.C.O.U.T (Eco-Friendly Smart Courier for Optimized Unmanned Transport) introduces a groundbreaking innovation in last-mile logistics. This fully autonomous delivery vehicle operates using solar, kinetic, and electric energy, enabling zero-emission functionality and significantly reducing its environmental impact. Eco-S.C.O.U.T is designed with sustainability, security, and reliability as top priorities. It features OTP-based parcel verification, real-time self-monitoring, and gyroscope-stabilized storage, ensuring that each package is delivered safely and accurately, even across challenging terrain and remote areas. The system addresses urban pollution and the inefficiencies of rural delivery networks while also serving as a strategic asset for developing eco-conscious infrastructure and smart cities. With its all-weather durability and intelligent automation, Eco-S.C.O.U.T can navigate complex environments without human intervention, helping to lower costs, reduce carbon footprints, and enhance service reliability. By combining advanced navigation, renewable energy integration, and a security-focused design, Eco-S.C.O.U.T represents a significant advancement in the evolution of sustainable logistics.

Key Words: autonomous delivery, sustainable logistics, zero emissions, package security, rural connectivity

1. INTRODUCTION

In today's rapidly evolving digital economy, automated delivery systems have become a crucial advancement in logistics and transportation. As consumer expectations lean toward faster and more reliable service, automation offers a scalable solution to address these growing demands, especially in regions where manual delivery is inefficient or unfeasible. Autonomous vehicles reduce operational costs, mitigate labor shortages, and ensure uninterrupted service across varying terrain and climate conditions by removing the dependency on human drivers. This is particularly beneficial in rural and hard-to-reach areas, where consistent and timely delivery has historically posed a challenge. Additionally,

automated systems are typically equipped with advanced navigation, real-time monitoring, and self-diagnostic technologies, which help minimize errors, improve security, and ensure packages are handled carefully. These innovations enhance the overall efficiency of last-mile delivery and support broader sustainability goals and digital integration within modern infrastructure (McKinsey & Company, 2021; World Economic Forum, 2020).

2. PROBLEM STATEMENT

E-commerce is advancing rapidly, while consumers increasingly demand faster, safer, and more eco-friendly delivery methods. This significantly pressures the already strained logistics and transportation industries undergoing numerous transformations. One of the most prominent changes is the excessive reliance on fossil-fuel-powered delivery vehicles, contributing to global greenhouse gas emissions. A staggering 30% increase is forecast by 2030 in the last-mile delivery emissions in urban areas by the World Economic Forum (2020), without considering sustainable alternatives. These industries' environmental challenges are exaggerated when human limitations bog down inefficient logistics systems.

Another danger is refusing to see the ever-present threat of package theft, erroneous delivery, and damage during handling in current delivery models. In this era where home deliveries have become necessary, carton stealing or mishandling leads consumers to bear economic losses and a lack of trust in service providers (Statista, 2022). Traditional vehicles are often ill-equipped for variable terrain and weather conditions, posing further challenges to rural and off-road deliveries. In the meantime, the existing system does not possess the self-monitoring capabilities to recognize internal breakdowns or delivery issues and prevent them from escalating into unanticipated downtimes and delays.

3. OBJECTIVES

The reason for creating this product is:

3.1 To Promote Environmentally Sustainable Delivery

Eco-S.C.O.U.T aims to reduce the environmental impact of logistics by using clean energy sources like solar panels, plug-in charging, and regenerative kinetic recovery. Eliminating fossil fuel usage supports greener transportation and aligns with global efforts to cut carbon emissions (International Energy Agency, 2021).

3.2 To Ensure Secure and Tamper-Proof Deliveries

With rising concerns about parcel theft and delivery errors, Eco-S.C.O.U.T. uses an OTP-based two-step verification system to ensure that only the intended recipient can access the package. This enhances consumer trust and reduces financial losses linked to stolen or misdelivered items (Pitney Bowes, 2025).

3.3 To Enable Reliable Delivery Across All Terrains

The vehicle's rugged, four-wheel-drive design ensures safe delivery in various conditions, with a gyroscope-stabilized compartment.

4. MATERIALS/METHODS

4.1 Product Description

Eco-S.C.O.U.T is a fully autonomous, eco-friendly courier vehicle powered by renewable energy, featuring gyroscope-stabilized storage, real-time damage detection, and GPS-guided delivery. Its durable design enables all-terrain driving and operation even when flipped upside down.



Figure 1: The Image of Eco-S.C.O.U.T

4.2 Step-by-Step Eco-S.C.O.U.T Delivery Process

The Eco-S.C.O.U.T delivery process begins with parcel registration and safe loading, where the sender registers the package via a mobile app or drop-off point, placing it into a gyroscope-stabilized compartment to prevent damage during transit. In Step 2, the system sets up route planning and navigation using GPS and intelligent mapping to determine the most efficient and eco-friendly path, even in rural areas. Step 3 involves an energy check and system activation, where Eco-S.C.O.U.T ensures sufficient solar power, switching to battery or kinetic energy when needed for uninterrupted travel. Finally, in Step 4: delivery and secure verification, the recipient receives a one-time password (OTP) to unlock the compartment, ensuring secure handover, followed by automated confirmation to both sender and recipient.

5. NOVELTY

Eco-S.C.O.U.T is an autonomous, zero-emission delivery vehicle powered by solar, electric, and kinetic energy, addressing the demand for faster and eco-friendly logistics. It replaces labor-intensive methods with AI-driven navigation, real-time sensors, and a gyroscope-stabilized compartment for safe, accurate deliveries. Built for rugged terrains, it reduces human dependency and operational errors. Its cost-effective design minimizes maintenance and carbon emissions. Inspired by NASA's Moon Rover, Eco-S.C.O.U.T is optimized for secure, long-term parcel delivery on Earth.

6. COMMERCIALIZATION POTENTIAL

Eco-S.C.O.U.T revolutionizes logistics by combining sustainability, automation, and terrain adaptability, aligning with global green goals and modern commerce trends. Its applications span e-commerce, urban couriers, postal services, and even humanitarian aid in remote or disaster-hit areas. Renewable energy reduces fuel and maintenance costs, enhancing commercial appeal. Its cost-efficiency supports companies seeking to cut expenses and environmental impact. Additionally, its secure verification system combats package theft and misdelivery, boosting customer trust and satisfaction.

7. BENEFIT TO COMMUNITY

The Eco-S.C.O.U.T is designed for modern communities, prioritizing sustainability, efficiency, and safety. As a clean-energy delivery vehicle using solar power, kinetic energy, and electricity, it operates with zero emissions, significantly reducing urban air pollution. It also effectively reaches rural and remote areas, providing essential goods to hard-to-access communities. With secure storage and innovative delivery mechanisms, it ensures packages remain protected during transit. Overall, the Eco-S.C.O.U.T promotes greener, smarter cities and enhances livability.

8. FEEDBACK FROM COMMUNITY

Survey findings from 37 participants reveal strong public support for online shopping and eco-friendly delivery technologies like Eco-S.C.O.U.T. The majority (56.8% agreed, 24.3% strongly agreed) reported frequently shopping online, reflecting the convenience, time savings, and product variety e-commerce offers. Additionally, most respondents (48.6% agreed, 29.7% strongly agreed) strongly support using eco-friendly technologies daily, suggesting increased environmental awareness and a shared commitment to sustainable living. Support for automated delivery robots in rural areas was also evident, with 43.2% agreeing and 16.2% strongly agreeing that such technology can enhance delivery efficiency. Although 32.4% were neutral, only a small number disagreed, indicating openness to tech-based solutions for rural logistics challenges. Further, 54.1% agreed and 29.7% strongly agreed that solar panels enhance Eco-S.C.O.U.T's sustainability, showing widespread approval of renewable energy use. Only 13.5% were neutral, with minimal disagreement, underscoring a preference for clean, reliable power sources. Respondents also recognized the specific benefits of Eco-S.C.O.U.T for rural areas, with 55.6% agreeing and 25% strongly agreeing that it addresses infrastructure and accessibility issues. This highlights the system's perceived potential to improve service in underdeveloped regions. Finally, 56.8% agreed and 27% strongly agreed that Eco-S.C.O.U.T represents a significant innovation in delivery services. The findings collectively indicate strong public support for sustainable, tech-driven solutions and a positive outlook toward integrating such innovations into everyday life for greater efficiency and environmental benefit.

9. CONCLUSION

Eco-S.C.O.U.T is a scalable solution for today's delivery challenges, integrating clean energy technology, intelligent automation, and robust security. It enhances accessibility in rural areas, reduces urban emissions, and ensures package security through user verification. By balancing environmental responsibility with convenience, Eco-S.C.O.U.T sets a new standard for sustainable and efficient delivery, positioning itself as a leader in greener solutions.

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Chapter 30

Vitellogenin Dipstick: Rapid Detection of Sexual Maturity in Catfish Species for Shariah-Compliant Aquaculture Innovation

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ABSTRACT

The sustainability and ethical progress of aquaculture is highly dependent on accurate, non-invasive tools to monitor the reproductive maturity of broodstock. The aim of this study was to develop and evaluate a vitellogenin dipstick, a lateral flow immunoassay for the rapid detection of vitellogenin (Vtg), a biomarker of sexual maturity, in female catfish to support Shariah-compliant aquaculture practises. Polyclonal antibodies were generated in rabbits using purified Vtg from *Hemibagrus nemurus* selected for its high Vtg expression. These antibodies were conjugated to gold nanoparticles and applied to nitrocellulose membranes to develop a field applicable dipstick. Plasma samples were collected from four catfish species, *Clarias gariepinus* (mature and immature), *Pangasius pangasius*, *Hemibagrus wyckioodes* and *H. nemurus*, and analysed in triplicate. The Vtg content was quantified by dipstick and competitive ELISA using optimised antibody dilutions of 1:500 to 1:8000 and standard Vtg concentrations of 125–500 ng/mL. SDS-PAGE confirmed the presence of Vtg bands (95–175 kDa) in females and the absence in males. Notably, *H. nemurus* had the highest concentration of Vtg in plasma (84.040 ± 5.33 mg/mL), while *C. gariepinus* (mature) had the lowest (8.539 ± 2.68 mg/mL). The Vtg dipstick showed high sensitivity by detecting Vtg in concentrations of up to 50 ng/mL within 10 minutes and showed a strong correlation with the ELISA and the gonadosomatic index ($r = 0.87$). The developed test strip is portable, cost-effective (<RM 5 per test) and eliminates the need for synthetic hormones, providing a humane and Shariah-compliant solution for aquaculture. In conclusion, the Vtg dipstick is a promising innovation for non-invasive monitoring of catfish reproduction that supports ethical breeding decisions and contributes to sustainable aquaculture practises.

Key Words: Catfish, Dipstick, Immunoassay, Shariah-Compliant Aquaculture, Vitellogenin

1. INTRODUCTION

Aquaculture contributes significantly to global food security by providing a sustainable source of protein (Franks *et al.*, 2021). However, there is a growing demand for ethical and Sharia-compliant practises in animal protein sources. Conventional methods such as hormone injections, biopsies and laboratory tests are often invasive, expensive and stressful for the fish (Evgenyevich, 2022). Hormone treatments can lead to problems with egg quality, abnormal gonadal development, infertility and ethical concerns, especially when derived from human urine (Hu *et al.*, 2020; Mylonas *et al.*, 2010; Sutriana *et al.*, 2022). This raises questions about halal integrity, as Muslim farmers and consumers are concerned about consuming fish that has been exposed to questionable substances ('mashbooh'). Therefore, non-invasive, Sharia-compliant alternatives are urgently needed to ensure ethical and sustainable aquaculture practises. Vitellogenin (Vtg), a liver-derived precursor of egg yolk protein, is a proven biomarker for sexual maturity (Daud *et al.*, 2016; Kochneva *et al.*, 2023). The aim of this study was to develop and evaluate a portable Vtg-based test stick for the rapid and non-invasive detection of sexual maturity in female catfish.

2. METHODOLOGY

Vitellogenin (Vtg) was purified from catfish plasma by ion exchange and gel filtration chromatography. Polyclonal antibodies were raised in rabbits by injection of purified Vtg mixed with Freund's adjuvant, followed by purification by affinity chromatography and freeze-drying for storage. Colloidal gold nanoparticles were conjugated with anti-Vtg antibodies and applied to a conjugate pad containing sucrose and trehalose. Lateral flow dipsticks consisted of sample pads, conjugate pads, nitrocellulose membranes (with test and control lines) and absorbent pads. Female plasma from *Clarias gariepinus*, *Pangasius pangasius*, *Hemibagrus wyckii* and *H. nemurus* was analysed for Vtg by SDS-PAGE and quantified using a competitive ELISA. The Vtg concentrations were correlated with the values of the gonadosomatic index (GSI). Tests were performed in triplicate and data were analysed using a one-way ANOVA and Tukey's post hoc test ($p > 0.05$). All procedures followed the Universiti Selangor ethical guidelines (UNISEL/CRIL/EC/0001).

3. RESULTS & DISCUSSION

3.1. Protein characterisation and sex-specific vitellogenin detection

Total plasma protein concentrations varied between catfish species, with *H. nemurus* having the highest (~0.1240 mg/mL) and mature *C. gariepinus* the lowest (~0.0987 mg/mL) (Figure 1(A)). Immature *C. gariepinus* had higher protein concentrations than mature broodstocks, indicating early Vtg synthesis. SDS-PAGE analysis confirmed the presence of a Vtg band (~95-175 kDa) in the plasma of females of all species, while male samples had weak or absent bands (Figure 1(B)). These findings demonstrate that Vtg is a reliable female-specific biomarker for reproductive maturity in catfish.

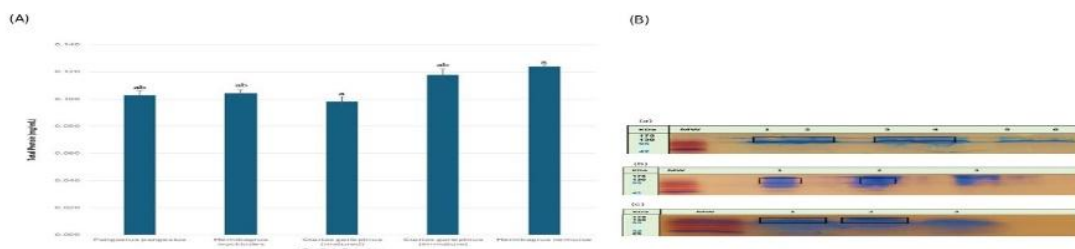


Figure 10: Total plasma protein and vitellogenin expression in female catfish. (A) Mean plasma protein concentration ($\pm$ SE) in *Clarias gariepinus* (mature and immature), *Pangasius pangasius*, *Hemibagrus wyckiodes*, and *H. nemurus*; (B) SDS-PAGE showing Vtg bands ($\sim$ 95–175 kDa) in female plasma; bands were absent in male samples, confirming sex-specific expression.

3.2. Antibody sensitivity and evaluation of reproductive biomarker

Antibody sensitivity (Figure 2 (A–C)) confirmed strong anti-Vtg binding at low antibody dilutions (1:1000), with higher Vtg concentrations producing stronger absorbance signals, confirming the sensitivity and specificity of the assay. The polyclonal IgG effectively detected Vtg in the range of 125–500 ng/mL. Figure 2 (D) shows a positive correlation between Vtg levels and the gonadosomatic index (GSI), with the highest values observed during the maturation phase. Lower Vtg and GSI values were observed in immature fish. These findings confirm Vtg as a reliable and non-invasive biomarker for reproductive maturity in female catfish.

3.3. Species-specific evaluation of vitellogenin in female catfish

Table 1 shows the species-specific differences in Vtg plasma levels. *Hemibagrus nemurus* had the highest Vtg concentration (84.040 ± 5.330 mg/mL), followed by *P. pangasius* and *H. wyckiodes*. *Clarias gariepinus* (mature and immature) had the lowest values. These differences reflect species-specific hormonal regulation, reproductive stage and liver activity during oocyte maturation (Warren *et al.*, 2021; Villeneuve *et al.*, 2023).

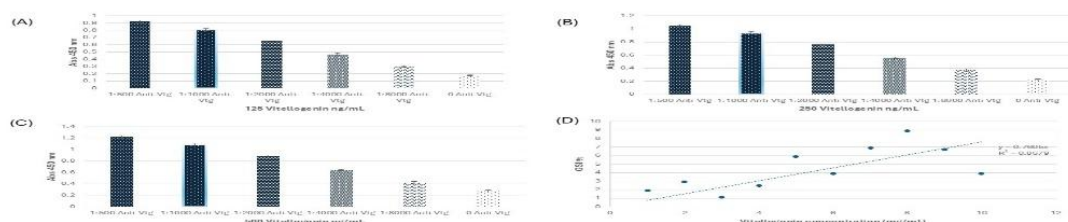


Figure 2: Antibody sensitivity and vitellogenin-GSI correlation in female catfish. (A–C) Antibody sensitivity shows absorption at concentrations of 125, 250 and 500 ng/mL Vtg; strongest binding was observed at dilutions of 1:500–1:1000. (D) The strong linear correlation ($R^2 = 0.86$) between Vtg concentration and GSI confirms Vtg as a reliable biomarker of maturation.

Table 2 Plasma vitellogenin concentration in female catfish: mean $\pm$ standard deviation. Superscript letters indicate statistically non-significant differences at $p > 0.05$ based on Tukey's post-hoc test.

Catfish species	Vitellogenin concentration (mg/mL)
<i>Clarias gariepinus</i> (mature)	8.539 $\pm$ 2.677 ^a
<i>Clarias gariepinus</i> (immature)	7.148 $\pm$ 2.988 ^a
<i>Pangasius pangasius</i>	26.662 $\pm$ 3.787 ^{ab}
<i>Hemibagrus wyckiodes</i>	21.958 $\pm$ 4.673 ^{ab}
<i>Hemibagrus nemurus</i>	84.040 $\pm$ 5.330 ^b

3.4. Commercialisation potential and application for Shariah-compliant aquaculture

Table 2 compares Vtg dipstick, ELISA, and conventional methods for assessing the maturity of broodstocks. The Vtg dipstick is inexpensive, fast (~10 minutes), portable and user-friendly, requiring only a drop of blood and no equipment. Unlike ELISA or hormone-based methods, it minimises stress, avoids synthetic chemicals and is in line with halal principles, making it suitable for use in the field (Kampeera *et al.*, 2021; Major *et al.*, 2022). This innovation allows non-experts to carry out on-site inspections, reducing reliance on invasive techniques. Its use supports ethical breeding practises, increases productivity and consumer confidence in Sharia-compliant fish products. The Vtg Dipstick therefore offers a scalable, sustainable solution that combines scientific accuracy with the practical needs of aquaculture.

Table 2 Comparison of vitellogenin dipstick, ELISA and conventional methods

Characteristics	Vitellogenin dipstick	Vitellogenin ELISA	Conventional method
Equipment	Device-free, portable	Requires laboratory equipment	Visual aids or biopsy instruments required
Ease of use	Very simple, one drop of blood, quick result (10 min)	Complex, multi-step, time-consuming	Requires trained personnel, subjective
Stress for the fish	Minimal, non-invasive	Moderate, blood sampling required	High stress; handling of hormones
Accuracy	High; recognises plasma Vtg	High, quantitative	Moderate; based on physical characteristics
Cost	Low (~RM 5/test)	High (~RM 6,000 for set-up)	Variable (labour, hormone costs)
Time to result	~10 minutes	Several hours to a day	Immediate, but low accuracy
Sustainability	Halal, hormone-free, ethical	Less hormone use, but invasive	Spawning induction, Often hormone-dependent

4. CONCLUSION

In this study, a rapid, Sharia-compliant Vtg dipstick was developed for the detection of sexual maturity in female catfish. It showed strong cross-reactivity, high sensitivity (50 ng/mL) and strong ELISA correlation. This tool supports the ethical, non-invasive assessment of broodstock and has the potential for wider field validation and commercial aquaculture applications.

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Chapter 31

EGGA 3.0 - Mastering English Grammar through Self-Directed Mobile Learning

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ABSTRACT

EGGA 3.0 (English Grammar Guide App 3.0) is an upgraded and improved version of the innovative mobile application for learning English grammar. This self-directed mobile learning app is developed as a tool to help learners master fundamental English grammar concepts independently. The application provides structured learning materials, focusing on five grammar categories: Parts of Speech in English, Tenses, Subject-Verb Agreement, WH-Questions, and Modals, which are organised on a digital bookshelf. Each category has clear and detailed notes with simple examples to make learning easier. After reading the learning material, learners can test their understanding by taking quizzes with multiple-choice questions. These quizzes do not have a time limit, but responses have to be entered in sequence, and only one attempt per question is allowed. The learners will receive an instant report with their score and grade once the quiz is completed. EGGA 3.0 enhances learning by fostering autonomy, providing instant feedback to the learners, and stimulating their interest through interactive material. As such, grammar becomes easy, fun, and effective for mobile device learners. This method helps students connect with the information in a meaningful way and pushes them to keep working on the grammar exercises. EGGA 3.0 offers a fun and personalised way to learn English grammar skills. This mobile app provides easy access to language resources, allowing learners to practise anywhere. In addition to classroom teaching, EGGA 3.0 offers a more casual way to learn language, which makes it more fun and useful for students. It leverages mobile technology to enhance engagement and accessibility in language learning. Based on the learners' feedback, the high mean scores showed that the users were satisfied with EGGA 3.0's overall multimedia elements, namely, its graphics, sound, textual content, interface, and usefulness. EGGA 3.0 was able to attract the learners' attention, and they displayed a desire to know more about the grammar learning app. Therefore, employing EGGA 3.0 for grammar learning may inspire students to develop and acquire their grammar abilities, offer a pleasant and dynamic learning environment for them, and give them a way to measure their own degree of grammatical knowledge.

Key Words: EGGA, English grammar, mobile-assisted language learning, grammar learning, self-directed assessment

1. INTRODUCTION

Mobile technology has changed education by allowing learning anytime and anywhere through mobile learning (M-learning). Mobile-assisted language learning (MALL) uses personal devices to give learners constant access to language resources (Fan et al., 2023; Kukulska-Hulme & Shield, 2008). MALL offers flexibility, personalisation, and social interaction, making language learning more appealing by combining mobile devices with online tools. To take advantage of these benefits, this paper presents the English Grammar Guide Application 3.0 (EGGA 3.0), an improved mobile application that focuses on teaching English grammar in a fun and effective way. The app aims to make grammar learning more enjoyable and help learners improve their skills more efficiently.

EGGA 3.0 is an improved mobile application that learners can use to learn fundamental grammar skills and assess their learning performance themselves. It is intended to be used as a self-directed assessment tool. By using the mobile platform, students can access study resources and take quizzes on Android-powered tablets or mobile devices (Figure 1). Parts of Speech in English, Tenses, Subject-Verb-Agreement, WH-Questions, and Modals are the five learning material categories that are currently offered in the learning app, which are arranged on a digital bookshelf (Figure 2). There are thorough, brief notes with straightforward examples for every category. After completing the self-instruction phase, students can take an exam to gauge how well they have understood the five grammatical categories on their own. Each category contains multiple-choice questions. After taking the quiz, a brief performance report with the score and grade will be shown (Figure 3).

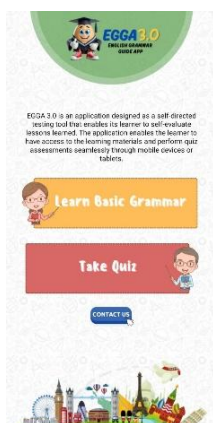


Figure 1: EGGA 3.0 Mobile App



Figure 2: The digital bookshelf – My Mini Library



Figure 3: The quiz score and grade

2. LITERATURE REVIEW

The way grammar is taught in language learning has changed a lot over time. In the early 1900s, grammar became popular again in schools, but later on, teachers started focusing more on teaching grammar through writing instead of just memorising rules (Hammond, 2023). The old way of teaching grammar did not motivate students much, so new, more interesting methods were developed (Lin, 2022). One important change is the use of the

communicative language teaching approach, which helps students speak fluently and communicate well (Frederick, 2015). Also, using educational tools has made learning grammar more active and creative for both teachers and students (Tu, 2022). Today, because many people use mobile devices, teachers are adopting mobile learning to help students improve their grammar skills (Ganapathy et al., 2016). Research shows that students like using mobile apps for learning grammar. For example, Solibar (2019) found that students improved their grammar after using a mobile app. The app helped them learn in a fun and meaningful way. Solibar (2019) suggested that mobile apps should be used for all grade levels to make learning more interesting and less stressful. It is also important that students use grammar in real conversations, not just memorise rules.

3. METHODOLOGY

A total of 54 students from UiTM Sarawak participated in this study. Their ages ranged between 18 and 24 years. The sample included diploma and degree students in their first and second semesters, drawn from various academic disciplines such as engineering, fine arts, agriculture, architecture, sports science, accounting, computer science, and business to ensure diverse representation. The participants were nominated by their class lecturers, who had been briefed by the researchers on the operation of the mobile application used in the study. Selection criteria included their roles as class representatives, varying levels of English proficiency (from average to advanced), and availability to participate. After trying the mobile app, the participants gave their feedback in a prepared questionnaire.

The study employed the Usability Instrument questionnaire, chosen for its strong validity and reliability, with a Cronbach's Alpha of 0.972 indicating high internal consistency. The instrument comprised three sections: (1) Respondents' Profile, (2) Evaluation of Multimedia Elements, and (3) User Satisfaction. Responses were measured on a five-point Likert scale, with satisfaction levels determined by the mean scores of each item, following the approach outlined by Landell (1997).

4. RESULTS & DISCUSSION

4.1 Results

The participants evaluated EGGA 3.0 based on several multimedia components: graphics, sound, interactivity, text, interface, and overall usefulness. The feedback was overwhelmingly positive across all categories, as follows:

- Graphics: Respondents appreciated the attractive colour scheme, clear visuals, and easy-to-understand explanations.
- Sound: The audio elements were rated highly for clarity, appropriateness, timing, and relevance.
- Interactivity: Users found the interactive features intuitive, easy to navigate, consistent, and well-designed, with an appropriate number of buttons and links.
- Text: The textual content was considered clear, concise, and easy to follow.
- Interface: Participants praised the user-friendly design, clear instructions, well-organised information, and helpful visual feedback.

- Usefulness: The application was seen as a valuable tool for learning, practising, and revising English grammar. Users also found it motivating and enjoyable.

Table 1 shows the mean scores and standard deviations of all the multimedia elements in EGGA 3.0. The overall analysis revealed that all multimedia elements in EGGA 3.0 received high mean scores ranging from 4.34 (SD=0.613) to 4.61 (SD=0.603). The results suggest that the participants were generally satisfied with all the multimedia elements in the mobile app, highlighting the effectiveness of the software in supporting English grammar learning and providing a positive user experience.

Table 1: The mean scores of all of the Multimedia Elements in EGGA

Items	N	Mean	Std. D
Graphic	54	4.49	0.515
Sound	54	4.34	0.613
Interactivity	54	4.46	0.531
Text	54	4.60	0.610
Interface	54	4.44	0.680
Usefulness	54	4.61	0.603
Valid N (listwise)	54		

4.2 Discussion

The positive feedback from the 54 participants highlights the effectiveness of EGGA 3.0 as a learning aid for improving English grammar. The high ratings across all multimedia elements suggest that the app successfully combines engaging visuals, clear audio, and interactive features to create an enjoyable learning environment. Particularly notable is the usefulness of the self-assessment exams, which allow learners to monitor their progress and identify areas for improvement. This feature supports personalised learning and encourages active engagement, which are key factors in language acquisition. Moreover, the intuitive interface and well-organised content make the app accessible to a wide range of users, including those who may not be tech-savvy. By providing a flexible, on-the-go learning experience, EGGA 3.0 complements traditional classroom instruction and helps learners practise grammar anytime and anywhere. In conclusion, the EGGA 3.0 mobile application demonstrates strong potential as a practical and motivating tool for English language learners. Its effective multimedia design and interactive features contribute to a positive user experience and support successful grammar learning outcomes.

5. CONCLUSION

The evaluation of EGGA 3.0 shows that it is an effective and user-friendly tool for learning English grammar. Participants responded positively to its multimedia components, including graphics, sound, interactivity, text, and interface design. The app's self-assessment exams and engaging features make grammar practice accessible, motivating, and enjoyable. Overall, EGGA 3.0 demonstrates strong potential to enhance English language education through innovative mobile technology.

6. RECOMMENDATION

Future research should explore the long-term effectiveness of EGGA 3.0 in improving English grammar proficiency over extended periods. Studies could investigate how consistent use of the app impacts learners' grammar skills compared to traditional classroom methods or other digital tools. In addition, research could also examine the app's usability and learning outcomes across diverse learner groups, including different age ranges, language backgrounds, and proficiency levels. Incorporating qualitative methods, such as interviews or focus groups, may provide deeper insights into user experiences and motivation.

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Chapter 32

Molecular Docking Study of Aptamer-Based Biosensor for Detection of Shiga Toxin (Stx) Protein from Escherichia Coli O157:H7

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ABSTRACT

The increasing prevalence of pathogenic *Escherichia coli* (*E. coli*) in water and food sources poses a significant threat to public health, necessitating the development of rapid and accurate biosensor detection methods such as aptamer-based biosensors due to their high specificity and sensitivity. Aptamers are nucleic acids that can bind with high affinity and specificity to a range of target molecules. This research aims to investigate biophysical mechanisms by utilizing biophysics simulations such as molecular free energy calculation and molecular docking to elucidate the interaction between specific aptamer with *E. coli* protein such as Shiga Toxin (Stx). The methodology involves characterizing aptamer-*E. coli* interactions, identifying key aptamer structural features and docking analysis of binding process between aptamer and *E. coli*. In conclusion, this research bridges theory for future applications, providing a framework for developing advanced biosensing technologies, by using the in-silico strategies that allowed the detection of aptamer-target interaction during molecular docking processes.

Key Words: *Escherichia Coli*; Aptamer; Protein; Molecular free energy; Molecular docking

1. INTRODUCTION

Enterohemorrhagic *E. coli* (EHEC), especially the O157:H7 strain producing Shiga Toxin protein (Stx), can cause serious foodborne illnesses like bloody diarrhea and hemolytic uremic syndrome (HUS) (Liu et al., 2022). With its rising presence in food and water, rapid and accurate detection method is critical. This study focuses on designing aptamer and Stx protein structures, performing molecular docking, and calculating Minimum Free Energy (MFE) and docking scores using HDock.

2. LITERATURE REVIEW

Aptamer-based biosensors have emerged as a promising tool for pathogen detection due to their high specificity, sensitivity, and stability. Aptamers are single-stranded oligonucleotides that fold into defined architectures and bind to targets such as proteins with high affinity and specificity. Aptamer is built with three structures, primary structures are built with a long sequence of nucleotides (A, T/U, C, G). The primary structures are fundamental for the secondary and tertiary structures. Next, secondary structures, generally a two-dimensional structure can form various secondary structures like hairpins, loops and bulges which contribute to their overall 3D shape and binding capabilities. The evaluation of good stability of these structures is according to their lowest molecular free energy (MFE) value. Lastly, tertiary structure or commonly known as three-dimensional (3D) structure enables aptamers to recognize and bind to their specific targets in molecular docking and molecular dynamic simulation (Liang et al., 2024). Furthermore, the ligand-protein docking is to predict how a protein interacts with ligands of known 3D structure (Mohanty & Mohanty, 2023). Docking score is an algorithm designed to compute the binding affinity of a protein-ligand complex and as an evaluation for good docking process (Yang et al., 2022). Simulating the binding at the atomic level emphasizes how the aptamer strongly binds to target, which affects the biosensor's selectivity and sensitivity.

3. METHODOLOGY

3.1. Aptamer preparation

The structure of aptamer was retrieved from Protein Data Bank with PDB code: 2AU4. Aptamer was shuffled using shuffleseq tools from usegalaxy.eu web server with 1000 number of shuffles. The validation of the aptamer's structures sequence was based on their molecular free energy (MFE) produced by RNALfoldz tools. The best five sequences from a thousand were chosen, has the lowest MFE value as presented in Table 1. This study uses RNAfold WebServer as it provides an interactive graphical output of the MFE structure or aptamer secondary structure as shown in Figure 1. From that, RNAfold WebServer was used to transform the FASTA sequence format into dot-bracket format. Then, the five sequences of aptamer chosen are generated in RNAComposer software for tertiary or 3D structure in PDB file format as in Figure 1.

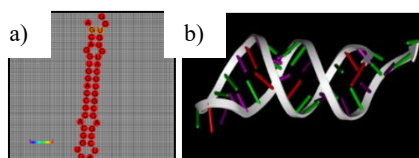


Figure 1: a) secondary structures b) tertiary structures of 2AU4 Aptamer for model 1

3.2. Target peptide/protein Escherichia coli preparation

The crystal structure of target protein Escherichia coli was retrieved from PDB code: 1C48 called as Shiga Toxin (Stx). Throughout this project, AlphaFold 3 were used as this software shows highly accurate prediction of the long peptide sequence structures. The 3D structures were visualized in Protein Data Bank (PDB) format using BIOVIA Discovery Studio software as shown in Figure 2 for analyse the Ramachandran plot. The Ramachandran Plot was used to confirm the structure of peptide generate by this software. Ramachandran Plot is a graphical representation of the dihedral angles, Phi (ϕ) and Psi (ψ) of amino acid residues in protein structures. It highlights regions for alpha helices (Q-I & Q-III) and beta sheets (Q-II), with some areas allowed, and others rarely used or unstable (Q-IV).

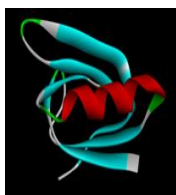


Figure 2: 3D structures of Stx in the forms of solid ribbon

3.3. Molecular docking of protein Escherichia coli and aptamer

Five chosen aptamers were docked with the protein Stx obtained from AlphaFold 3 as it shows stable structures as shown in Ramachandran plot, Figure 3. HDock server is a protein-protein and protein-DNA/RNA docking based on a hybrid algorithm of template-based modelling and ab initio free docking. The molecular docking process was using HDock server without any adding specification, and the results showed top ten possible docking residues prediction for each of five specific chosen aptamers and Stx protein in the PDB files format to be analyzed in the BIOVIA.

4. RESULTS & DISCUSSION

4.1. Structures of candidate aptamers and target protein Escherichia coli

Result from the Table 1, conclude that the aptamer model 1 has the lowest MFE values from RNAfoldz tools which is -24.0 kcal/mol and followed by model 2 and 3 which are -23.4 kcal/mol and -22.6 kcal/mol. However, for models 4 and 5, the MFE values are the lowest. These results suggest that all the 2AU4 aptamer sequences exhibit lower MFE, suggesting structural stability (Alkriz & Joujeh, 2024).

From the Ramachandran plot, Figure 3, Stx protein operated in AlphaFold 3 visualize that both regions, β -sheets (quadrant II) and right-handed α -helix (quadrant III) are the most prevalent structure in Stx. This suggest that Stx structures imparts stability to proteins and is crucial for their proper folding and function.

Table 1 Molecular free energy (MFE) values for the best five aptamer models from RNALfoldz tools

Aptamer Model	Aptamers sequences	MFE (kcal/mol)
1	AGCAGGUGGACCGCACGGUGAUCCGAGCGGUUCAUGUGUGG	-24.0
2	ACGGUUAGGGUGGUGGGGAACCACCACCGUUGAUCGCUGGG	-23.4
3	ACCCUCGAAACGGCGAGCGAGGGUGUCGUGUUUGAGGGGU	-22.6
4	CUGGGGAGGCAAGCUGGGGACCGUAGCUUGCAGUCCUGGAU	-20.5
5	AGUAGCUGGAUGGCGACACUCAGUGGGCGUCGUGGUCGAGC	-20.0

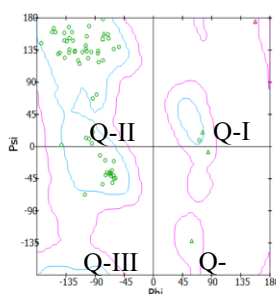


Figure 3: Ramachandran plot for AlphaFold 3

4.2. Molecular docking analysis

The analysis in 3.1 concludes that all of the 2AU4 aptamer structures are stable to be docking with AlphaFold 3's structures to estimate the binding affinity. The docking scores of the best prediction model in each of the five chosen aptamers with Stx are presented in Table 2, where the aptamers are ranked based on their docking scores. In general, the lower the rank, the better (Abd Halim et al., 2022). The results show that model 3 have the lowest docking scores of -267.50 as shown in Figure 4. This is followed by model 2 and 5 with the binding energy of -250.90 and -244.88 respectively. However, even though model 1 has the lowest MFE values, it has higher docking scores of -232.13 compared to model 3, 2 and 5.

Table 2 Docking scores for the best prediction model from five aptamer models from HDock

Aptamer model	Aptamer sequence	Docking scores
3	ACCCUCGAAACGGCGAGCGAGGGUGUCGUGUUUGAGGGGU	-267.50
2	ACGGUUAGGGUGGUGGGGAACCACCACCGUUGAUCGCUGGG	-250.90
5	AGUAGCUGGAUGGCGACACUCAGUGGGCGUCGUGGUCGAGC	-244.88
1	AGCAGGUGGACCGCACGGUGAUCCGAGCGGUUCAUGUGUGG	-232.13
4	CUGGGGAGGCAAGCUGGGGACCGUAGCUUGCAGUCCUGGAU	-220.23



Figure 4: 3D structures of best aptamer model 3 (white) binding with target protein Shiga Toxin (blue/red) in molecular docking with -267.50 docking scores

5. CONCLUSION AND RECOMMENDATION

In this study, in-silico methods, including MFE calculation and molecular docking, were used to evaluate aptamers against the target protein of *E. coli*. The 2AU4 aptamer model 3, Figure 4, showed the lowest MFE (-23.4 kcal/mol) and docking score (-267.50), making it the best candidate for further Molecular Dynamics (MD) simulations to assess structural stability through RMSD and RMSF analysis. In conclusion, the strong docking results suggest this aptamer could be a useful detector in future aptamer-based biosensors, such as colorimetric sensors for detecting Shiga Toxin protein in *E. coli* O157:H7.

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Chapter 33

SmartSteps English

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ABSTRACT

The current digital era of education demands that educators proactively adapt their teaching strategies and utilise innovative tools to tailor learning experiences that address the diverse needs of pupils. However, conventional grammar instruction often presents limitations in engaging learners with diverse learning styles, with predominant passive methodologies and practices. Compounding this issue is the limited availability of centralised, readily accessible, high-quality learning resources that align with the Standards-Based English Language curriculum (SBELC), further hindering effective grammar acquisition in primary education. To address these gaps, SmartSteps English was developed as a dynamic, digitalised platform that spearheads both teacher and learner-centred pedagogies. Aligned with the SBELC, this platform delivers interactive modules and structured lessons that are accessible and engaging. This pioneering digital platform further distinguishes itself through interactive exercises designed to foster active engagement and incorporates gamified elements that have been empirically demonstrated to enhance pupils' motivation. Additionally, SmartSteps English prioritises 21st-century learning through contextualised activities and collaborative tasks that extend beyond the traditional classroom environment, making it a strategic flipped-classroom tool. The efficacy of SmartSteps English was empirically evaluated through a pre-test and post-test study conducted with a sample of Year 4 respondents (N=25). The results indicated that 100% of respondents successfully achieved the specified learning objectives, with statistically significant improvement in grammar mastery observed post-observation. The findings strongly conclude that SmartSteps English is a robust, promising solution for the demands of 21st-century education.

Keywords: SmartSteps English, grammar instruction, digital learning platform, Standards-Based English Language Curriculum (SBELC), 21st-century learning

1. INTRODUCTION

The rapid advancement of digital technologies demands a transformative shift in educational practices, yet primary ESL grammar teaching in Malaysia still relies on outdated pedagogical practices, especially passive drilling techniques that fail to engage pupils (Ash'ari et al., 2024). This incongruence is further exacerbated by the lack of centralised, high-quality grammar

learning resources tailored to pupils' diverse needs (Wulandari et al., 2022). As a strategic response, SmartSteps English emerges as a groundbreaking digital platform that champions both teacher-centered and learner-centered pedagogies. Aligned with the Standards-Based English Language Curriculum (SBELC), SmartSteps English distinguishes itself through interactive exercises and structured lessons alongside gamified elements proven to enhance pupils' overall learning experience (Hwang et al., 2022). As a strategic flipped-classroom tool, SmartSteps English positions itself as a foundational pillar in transforming primary ESL education in Malaysia.

2. LITERATURE REVIEW

The global educational landscape has undergone a monumental shift in recent years, which has forced an urgent embrace of digital learning and literacy amongst pupils and teachers. Tandemly, the Malaysian Digital Education Policy (DEP) 2023 was launched, articulating a clear vision to harness digital tools and resources to elevate the learning quality and accessibility of education for Malaysian students (The Star, 2023). This advancement has compelled teachers to revolutionise their teaching practices and leverage innovative tools to maximise 21st-century learning, tailored to pupils' learning needs and preferences (Nordin & Alias, 2023, as cited in Jayasilan & Kandasamy, 2025).

Despite these notable advancements, current pedagogical practices in this niche are still largely dominated by passive, rote drilling techniques (Chun & Sathappan, 2022). Additionally, there exists a lack of interactive and stimulating learning tools that are adaptable and tailored to cater diverse learning needs of primary Malaysian ESL pupils (Wulandari et al., 2022). Adding to these pedagogical limitations is the scarcity of centralised, high-quality grammar resources that align with the SBELC (Ong & Tajuddin, 2021). Failing to provide such resources risks undermining the broader goals of 21st-century learning (Kaur et al., 2023) and poses a significant impediment to Malaysia's ambitious quest to achieve Sustainable Development Goal 4 (SDG 4), which advocates for the provision of inclusive and equitable quality education (UNESCO, 2025).

In tandem with stated challenges, SmartSteps English emerges as an innovative digital platform that advocates both teacher and learner-centered pedagogies to enhance grammar learning. Aligned with the SBELC, it delivers structured lessons while featuring gamified interactive exercises that elevate pupils' overall learning experiences (Idris et al., 2020). This feature has been strategically added in response to significant improvements demonstrated through gamified tools like Quizziz and Kahoot! (Jayasilan & Kandasamy, 2025). On a broader scale, global trends also support this direction, with pupil respondents in Indonesia expressing specific interest in interactive grammar exercises (Permatasari et al., 2024). Ultimately, SmartSteps English represents an innovative approach that establishes itself as a novel benchmark for efficacious, stimulating, and future-oriented grammar learning.

3. METHODOLOGY

To evaluate the efficacy of SmartSteps English, a pre-test post-test was conducted involving Year 4 pupil-respondents (N=25). Respondents' initial grammar competence was assessed via a pre-test instrument, followed by the intervention featuring modules, gamified exercises and contextualised activities focused on regular verbs. An identical post-test was later

administered. The results of these findings were quantitatively analysed and subsequently presented in the form of clustered bar graphs.

4. RESULTS AND DISCUSSION

Figure 1 presents a comparative overview of pre-test and post-test scores. Pre-test results demonstrated that a large fraction of respondents (56%, $n=14$) failed to score any marks, indicating a significant deficiency in grammar mastery. This finding supports a study by Amir (2021), who noted that most Malaysian primary ESL learners struggle with grammar. Additionally, merely 20% ($n=5$) secured scores exceeding 80%, illustrating that only a few pupils had attained a strong command of grammatical rules prior to the intervention.

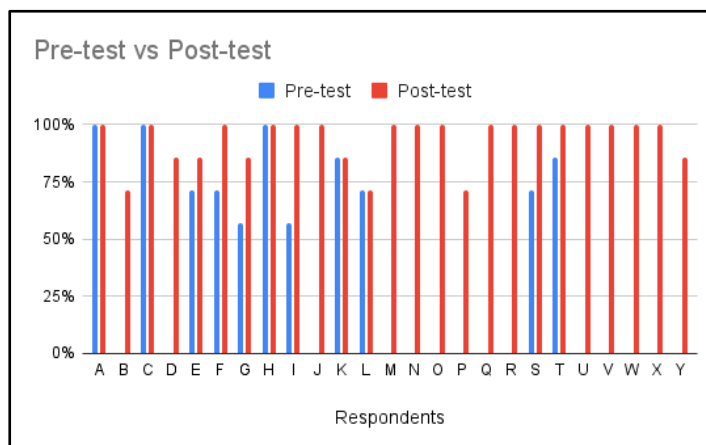


Figure 1: Pre-test vs Post-test Results

Post-test data indicated a remarkable improvement across all respondents, with 68% ($n=17$) of pupils obtaining perfect scores of 100%, while the remaining 32% ($n=8$) recording scores of 70% and above. This indicates a strong conceptual understanding of grammar following the strategic integration of gamified tasks and interactive content aimed at increasing pupils' motivation and reinforcing grammatical comprehension. As it is, Ambikapathy et al. (2024) posited that digital gamification approaches heightened both participant engagement and knowledge retention among Malaysian primary ESL pupils.

However, the most significant finding is the complete absence of respondents in the lower result attainment bracket post-intervention. This trajectory implies that the intervention has significantly benefited pupils' grammatical acquisition and learning, whilst providing effective support for pupils with lower grammar comprehension. This aligns with Bharathi's (2023) findings advocating for digital tools to cater to the diverse requirements of ESL learners and mitigate performance disparities within the classroom. As such, the results affirm that SmartSteps English successfully bridges and promotes equitable progress in pupils' learning.

The findings highlight SmartSteps English as a formidable and transformative digital tool for the enhancement of grammar instruction in Malaysian primary schools. Its ability to elevate overall pupil performance establishes SmartSteps English as an indispensable

resource in sustaining curricular relevance in Malaysian 21st-century primary ESL classrooms.

5. CONCLUSION & RECOMMENDATION

In addressing the persistent challenges within Malaysian ESL grammar practices, SmartSteps English has emerged as a strategic and innovative solution. Aligned with the SBELC, its interactive and accessible framework fosters inclusivity and engagement, positioning itself as an invaluable digital resource for teachers and learners in 21st-century classrooms.

Moving forward, SmartSteps English will be expanded to cover grammatical components across primary year levels. This is to ensure equitable accessibility for all teachers and pupils to curriculum-aligned resources. It enables teachers to deliver tailored instructions, accommodating diverse learning needs, and encourages consistent grammar advancement throughout the primary school years.

Furthermore, recognising that education transcends beyond classrooms, future expansion of SmartSteps English includes actively integrating parental involvement. By offering accessible onboarding materials, regular pupils' progress updates, and a dedicated "Parent Corner" featuring tips and simplified grammar guides, SmartSteps English aims to cultivate a linguistically supportive home environment that reinforces and extends pupils' language learning beyond conventional practices.

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Chapter 34

Solar SkyHaul Hybrid Drone

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ABSTRACT

Currently, the use of drones helps industries extensively, offering faster operations, improved efficiency, and access to hard-to-reach areas. The Solar SkyHaul, a hybrid solar-powered drone, is one of our products that was created to overcome the problems of traditional drones, including their short battery life, small payloads of capacity, and susceptibility to environmental factors. The drone's integration of lithium-Sulphur batteries and high-efficiency solar panels greatly increases flying time and lowers carbon emissions, both of which are in accordance with international sustainability objectives. Its objective is to provide more dependable and adaptable UAV solutions for delivery, surveillance, agriculture, and emergency response applications. A cargo capacity of up to 15 kg, adaptive mission planning, and real-time environmental sensors for danger identification are among its novel characteristics, which make it appropriate for crucial logistics in remote or disaster-affected locations. According to our survey of 31 respondents, there is considerable support (87.1%) for the use of drones for parcel delivery. Users acknowledge the efficiency and environmental benefits of this technology, although some are concerned about security and weather effects. The potential for commercialization of drones is significant, especially in the courier, medical, and humanitarian sectors where quick, self-sufficient delivery is crucial. By facilitating operations in areas with inadequate infrastructure and reducing operating expenses, Solar SkyHaul has the potential to revolutionize logistics and promote sustainable development objectives. As to conclude, this invention offers a forward-thinking solution for robust, environmentally friendly aerial transport systems by fusing renewable energy, intelligent automation, and sophisticated design.

Key Words: Hybrid drone; Solar power; Parcel delivery; Sustainability; Emergency logistics

1.0 INTRODUCTION

1.1 Objectives of the innovation

As the world looks for smarter and cleaner ways to use technology, drones are becoming more crucial than ever for deliveries, surveillance, farming, and even disaster relief. But most drones today still rely heavily on batteries that run out quickly, or fuel that's not exactly eco-friendly. With drastic delivery and renewable energy technological advances, we have welcomed innovative practices by investing in a solar SkyHaul. This innovative drone integrates solar power with traditional propulsion systems to enhance flight capabilities, reduce carbon emissions, and promote operational efficiency. However, Solar SkyHaul is a project focused on creating a hybrid drone powered by both solar energy and batteries, designed to fly longer, use less power, and help reduce environmental impact. The goal is to build a drone that's not only efficient and reliable but also versatile enough for doing deliveries, surveillance, agriculture, or emergency response. By combining clean solar power with smart batteries, Solar SkyHaul aims to solve the common problem of short drone flight times and constant recharging, while promoting more eco-friendly technology in the skies.

1.2 Problem statement

As in the early phases of existing drones, several restrictions impeded their overall functionality and how useful they are. These drones (UAVs) were revolutionary in the fields of air mobility and remote controlling, but they also had crucial drawbacks. Furthermore, to affect the effectiveness and range of drone operations, these flaws clearly stated that continuous technological development is required to increase the autonomy, adaptability, and dependability of drones. There are some problems or issues that have been stated in some articles or research on the existing drones they might face, such as battery life, reliance on manual control and minimal payloads.

Battery life is the first problem that can be identified from other existing drones. Its dependence on battery power, which severely limited flying time, was one of the main drawbacks of early drone technology. Battery-powered drones could typically only run for 20 to 40 minutes on a single charge. As this makes the existing drones less useful since they have to recharge their drones every time after making a few deliveries. (Milano, 2022). Next, the dependence on manual control. These existing drones lacked advanced autonomous systems which had to be operated with manual remote controllers. As technology progressed, sensors such as Global Positioning Systems (GPS) and Inertial Measurement Units (IMUs) were added to enable more autonomous flight capabilities. Until then, human control made processes more challenging and limited their scalability and reliability in some applications. (Daly, 2012). Last problem is small payloads. Due to the small payload capacity of the existing drones, which typically only allowed them to carry a few kilograms or less, existing drone models were frequently constrained. This significantly limited its ability to move big, go deliver a longer time or to carry bulky objects like delivery bundles, advanced cameras, or sensors. Due to their modest or small size, these drones were unable to incorporate larger motors or payload bays, which further limited their practical versatility. (Singleton, 2024)

2.0 LITERATURE REVIEW

2.1 Key features and uniqueness

The Solar SkyHaul Drone is an intelligent, energy-efficient drone released into the air. It uses a hybrid energy system that combines lightweight lithium-sulfur batteries for backup power with monocrystalline solar panels, which are recognized for their high efficiency. For safety, the drone has real-time environmental sensors made by durable polycarbonate casings, featuring MEMS and RF/ optical sensors that detect weather hazards such as heavy rain and thunderstorms, and are linked with gold and copper circuitry for stable operation. With a solid yet lightweight carbon fiber structure, the drone can carry up to a maximum 15 kg.



Existing product



Solar SkyHaul drone

Due to the combination of three key features, this product can be classified as unique that sets it apart from other existing drones on the market. First of all, the Solar SkyHaul has a hybrid energy system that uses solar panels to generate electricity during the day and effortlessly switches to its battery backup system when sunlight is lacking. This greatly increases its flying time and enables continuous operation even when there are no recharging locations nearby. The second is that the drone is equipped with real-time environmental sensors that constantly monitor weather-related data, including wind speed, temperature and air pressure. The unique feature of the drone is that it uses data to detect any potential hazards, such as thunderstorms or hurricanes, and can locate and land itself in a secure area to seek shelter until the weather clears up. This greatly reduces the probability of the parcel to be damaged and protects the payload. Lastly, compared to many other drones in its category, this one is capable of lifting objects up to 15 kilograms due to its maximum payload capacity. This feature enables the drone to transport emergency relief or medical supplies in just one trip without sacrificing efficiency or stability.

3.0 METHODOLOGY

3.1 Instruction on How to Use the Product

Step 1, takeoff. A 15 kg payload is sealed and secured. Batteries are fully charged, and GPS sets a 30 km route factoring in restricted airspace and weather. The drone ascends using battery power, then shifts to solar-assisted flight via its hybrid power system. Step 2, Mid-Flight Energy Management: During flight, solar panels on the wings generate power and recharge batteries. In low sunlight or cloud cover, backup power ensures steady flight through

dynamic energy switching. Step 3, Descent and Approach: Nearing the destination, the drone begins a controlled descent using GPS, timing sensors, and visual cameras to locate the landing zone precisely. Step 4, Delivery and Return: The drone lands in the designated area and releases the 15 kg payload. It then performs a system check and either returns to base or heads to a charging station, guided by its hybrid system.

3.2 Target users and Application Areas

Our drone invention is excellent for customers and industries who require reliable, efficient delivery in unreachable areas. Target users include military units, emergency assistance organizations, healthcare organizations, and logistics companies that work in developing nations. For example, the drone can be used to deliver essential medical supplies like blood, vaccines, or kits for emergencies to hospitals and health departments in rural or disaster-affected areas on time. The drone's ability to deliver information or technical equipment to isolated bases without exposing personnel is crucial to military units. Moreover, it can be used by emergency relief organizations for carrying supplies of food, water, and shelter to areas trapped by landslides, earthquakes, or floods.

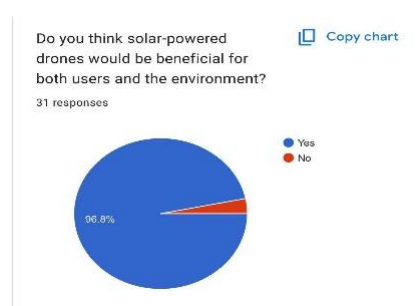
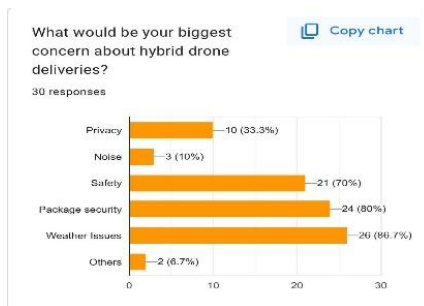
4.0 RESEARCH AND METHODOLOGY

4.1 Survey and feedback

Our group has conducted a survey on our innovation the Solar SkyHaul hybrid drone which includes 31 respondents that involves both gender male and female. There are 6 questions that we provide in our survey related to our innovation. Here are some of the results that we collected from each question from our respondent.



The data shows that 58.1% of respondents are aware of electric-powered drones for parcel delivery, while 41.9% are unaware of hybrid drones. Next, data also shows that drones can save time compared to traditional methods, with 29 respondents agreeing and 2 disagreeing, suggesting they may make delivery faster.



The pie chart shows that 96.6% of respondents believe hybrid drones can benefit users and the environment, with 30 people agreeing. However, concerns about weather, package security, noise, and privacy are the top concerns for consumers when using hybrid drones for parcel delivery. Therefore, based on the survey we innovated solar SkyHaul to make it easier for the user to ship out their parcel and also provide a good shipping service to the customer as most of them prefer to order products online. It shows that half of the respondents agreed with our innovation to be put in the parcel delivery.

5.0 COMMERCIALIZATION AND IMPACT

5.1 Potential for Commercialization

Hybrid drones are being commercialized in the courier industry to meet customer demands for faster delivery times and cost-effectiveness. These drones can reach geographically challenging or expensive areas, allowing new markets and consumers. They also provide operational flexibility without the need for large car companies or extra drivers. Logistics stakeholders are exploring drone technology to lower operating costs, cut emissions, and meet consumer demands for immediate and on-demand delivery. Drone integration helps courier businesses remain creative and competitive in a rapidly changing market by establishing relationships with technology companies and creating new logistics models.

5.2 Benefits to the community for End Users

The Solar SkyHaul drone offers substantial benefits to users by offering reliable, energy-efficiency, and autonomous transport. By using solar energy as its main power source, it greatly reduces operating costs and delays, particularly in rural areas. Its hybrid battery backup maintains uninterrupted operation in poor weather. This drone offers a maximum to 15-kilogram capacity, makes it perfect for logistics, and can deliver standard items such as medical supplies, equipment, or other necessities to unreachable areas by car (World Health Organization, 2021). Real-time environmental sensors improve decision-making by monitoring weather. This enables the drone to reroute during storms, crucial for emergency aid (United Nations Development Programme, 2023). From a community perspective, the Solar SkyHaul promotes sustainability and disaster protection. The use of renewable solar energy helps reduce carbon emissions compared to typical fuel-based or fully battery-reliant drones, supporting the International Energy Agency's worldwide climate goals (IEA,2022). It

can be a lifesaver in emergency situations, isolated flood zones, or rural areas. Such functions are crucial for environmental monitoring, healthcare access and rural development (World Health Organization, 2021).

6.0 CONCLUSION AND RECOMMENDATION

In conclusion, green delivery and transportation benefit significantly from the development of hybrid solar drone shipping systems. Solar-powered drones become more reliable for power management when they combine traditional energy storage methods like batteries or fuel to overcome weather and energy obstacles. Hybrid drones obtain the capacity to operate longer journeys and maintain flexibility and reliability through their dual power supply mechanisms thus their suitability for most delivery usages extending from distant territories to underserved areas (Ghadeer, 2024). Solar SkyHaul aims to develop integration of Adaptive Mission Planning AI technology. The AI system achieves routing optimization through sensor input from cameras and LiDAR equipment in addition to weather instrumentation to perform obstacle avoidance while re-routing for adverse weather situations. The real-time adaptability capability serves as an essential element for reaching peak performance along with durability and self-operation in solar-powered drones regardless of unexpected environmental conditions (Bharadwaj, 2025).

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Chapter 35

Work Buddy – A Virtual Co-Working Experience

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ABSTRACT

The innovative project “Work Buddy—A Virtual Co-Working Experience” introduces a productivity tool designed to address the growing challenges of maintaining motivation, productivity, and focus while working alone in a remote setting. In an independent work environment, many individuals struggle with reduced motivation, procrastination, and feelings of isolation. To address these issues, this project, Work Buddy, offers a digital solution by simulating a real-time co-working environment through an immersive Pomodoro-based pre-recorded video session. The video features 25-minute work intervals followed by 5-minute scheduled breaks. It aims to immerse the user in an experience similar to engaging with a live co-working environment, providing a virtual sense of presence and companionship. The video incorporates culturally relevant Malaysian background music and includes a timer to encourage focused work for a set duration without distractions. This tool is designed for those who engage in independent or remote work settings, including educators and students, aiming to foster intentional productivity by transforming passive video consumption into an active, shared working experience. Preliminary implementation of this virtual co-working productivity tool suggests positive user engagement and perceived improvements in productivity and motivation. This innovation has taken steps for copyright protection through MyIPO and has been submitted for publication in an academic journal. Work Buddy demonstrates strong potential for scalability, commercialisation, and environmental sustainability through its fully digital delivery format. This project not only introduces a novel approach to virtual co-working but also hopes to contribute to the growing body of literature on digital productivity tools and remote work environments.

Key Words: Virtual Co-Working, Productivity Tool, Remote Working, Pomodoro Technique

1. INTRODUCTION

Remote working and online learning have fundamentally transformed how individuals engage with their tasks. It is undeniable that working independently offers flexibility and autonomy. However, this environment has also created a set of challenges, particularly in terms of

productivity, reduced motivation, procrastination and feelings of isolation. Many remote workers and students may experience struggles in maintaining good levels of motivation and productivity while working independently. These issues, if left unaddressed, will hamper good performance, high engagement and strong motivation. In response to these issues, the innovation project, Work Buddy – A Co-Working Experience, was developed and introduced as a digital productivity tool designed to stimulate co-working environments and provide a sense of companionship. It aims to introduce a structured and humanised approach to visual co-working through a one-hour immersive video-based session by integrating proven time management strategies, the Pomodoro technique. Through this virtual companion experience, this innovation offers users a sense of presence and accountability while working alone.

2. LITERATURE REVIEW

Humans are inherently social beings; handling tasks alone may significantly affect their well-being, mental state and emotions. According to Yang & Swekwi (2012), unusual circumstances of isolation may expose mental health to a vulnerable state, which further leads to regressive development in emotional behaviour among students.

In the meantime, digital tools such as “Study with Me” (SWM) videos have gained recognition for their ability to offer virtual companionship and other various benefits, including shaping learners’ motivation (Bahja et al., 2021; Ren et al., 2025). SWM videos enable users to experience the feelings of studying together in a shared virtual environment, even in isolation. According to Ibtasar et al. (2022) and Jin (2022), SWM also allows users to experience virtual companionship with less pressure. However, many existing SWM videos lack cultural relevance and structure thus limiting their effectiveness in different contexts.

In parallel, the Pomodoro Technique, introduced by Francesco Cirillo in the early 1900s, is considered a simple yet extremely powerful tool in time management strategies (Burton, 2016). Typically, a Pomodoro session involves the integration of 25-minute work intervals followed by a 5-minute short break. Several studies suggest that integrating SWM videos aids in maintaining focus (Szupunar et al., 2013; Zahariades, 2015).

3. METHODOLOGY

The development of Work Buddy – A Co-Working Experience followed a three-phase innovation stage: i) The Preliminary Implementation Stage, ii) The Production Stage and iii) The Publicising Stage.

3.1 Stage 1: The Preliminary Implementation Stage

In the initial stage, a perception-based study was conducted among a group of diploma students in UiTM Cawangan Negeri Sembilan Kampus Rembau to investigate the role of virtual co-study videos or the Study with Me (SWM) videos in university student learning and their overall impact on learning motivation. The study employed a quantitative descriptive research design using a questionnaire as the instrument. The results indicated that these videos positively impact students on their learning motivation.

3.2 Stage 2: The Production Stage

Building on the promising results of the preliminary implementation, the second stage involved the production of the Work Buddy – A Co-Working Experience video. This one-hour video was personally recorded in a realistic work setting. It is intentionally designed to replicate the environment of a live co-working space. The video incorporates the Pomodoro Technique, featuring 25-minute work intervals followed by 5-minute breaks. To enhance the immersive experience, the video includes a visible timer that allows users to feel encouraged and focused while working or studying for a set duration. Malaysian background music is also incorporated in the video to reflect local identity.

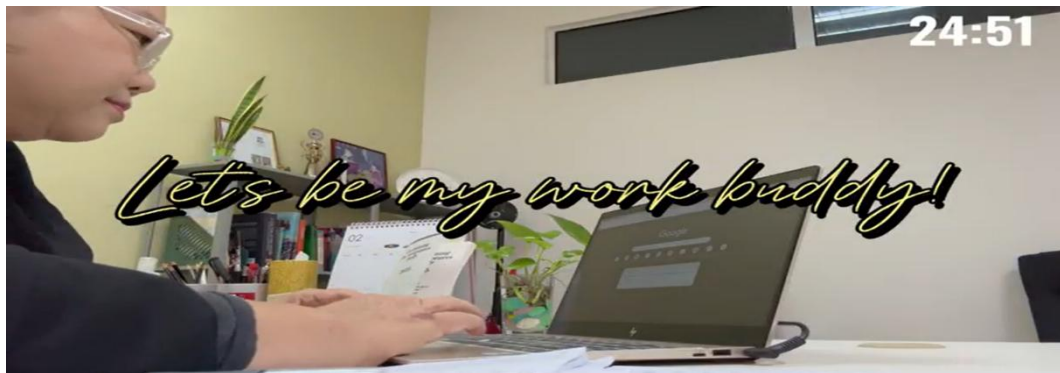


Figure 11: The Production of Work Buddy Video

3.3 Stage 3: The Publicising Stage

Upon completion, the Work Buddy – A Co-Working Experience was made available to the public through an open-source platform, YouTube, with copyright protection obtained via MyIPO (Intellectual Property Corporation of Malaysia). The selection of open source is to encourage the widespread use and accessibility of the videos. Users can now freely access the video and begin a synchronised and focused working or studying session wherever they are.

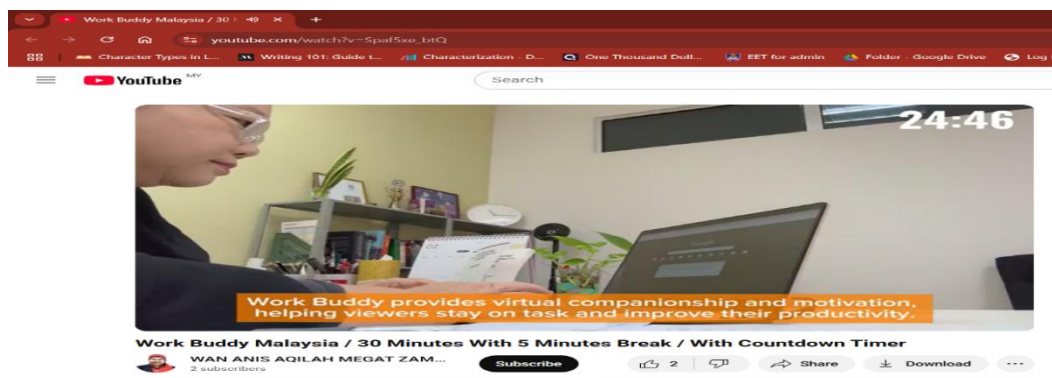


Figure 12: The Publicising Stage of Work Buddy video

4. FINDINGS AND DISCUSSION

The initial observation on the SWM videos, the digital productivity tool, yielded a positive reception among respondents. It is reported that the tools managed to provide a boost in students' learning motivation based on the overall means as presented in Table 1.

Table 1: The Impacts of the SWM Videos on Students' Learning Motivation

Items		Mean
1.	The SWM videos helped me develop a consistent study routine.	3.79
2.	The SWM videos helped reduce procrastination during my study sessions.	3.98
3.	I feel more productive after studying with the SWM videos.	4.06
4.	SWM videos have influenced my academic performance positively.	3.83
5.	I would recommend SWM videos to others as a study aid.	4.24
6.	I complete tasks more efficiently during study sessions with these videos.	3.94
7.	My time management has improved when studying with SWM videos.	3.85
8.	I perform better on exams or assignments after using the SWM videos.	3.87
9.	I can study for longer periods when using SWM videos.	3.85
Overall		3.93

Based on the positive findings, the current innovation is designed and aimed at targeting diverse groups, including remote workers, educators and even students. One of the key strengths of Work Buddy – A Co-Working Experience is its unique features. The integration of the Pomodoro Technique as a time management strategy within the one-hour video sessions allows for a structured format when dealing with any tasks. Plus, the accompaniment of Malaysian background music and a timer further differentiates Work Buddy – A Co-Working Experience from the generic SWM videos. This innovation also maintains its originality by providing an immersive experience of a real-time co-working environment.

5. CONCLUSION AND RECOMMENDATION

Work Buddy – A Co-Working Experience represents an innovative response to the widespread challenges faced by individuals who engage in remote work or study. By integrating the real-time co-working environment, proven time management strategies, the Pomodoro Technique, and cultural identity, the innovation not only aids in enhancing productivity but also benefits users' emotional and psychological needs. Work Buddy – A Co-Working Experience is more than just a video. It offers users a virtual working companion that extends further to high productivity, strong motivation and a sense of presence while dealing with an isolated environment. This innovation also demonstrates its high scalability, which effectively serves a diverse group of individuals who engage in work or study within isolated environments. As a fully digital productivity tool which uses an open platform, Work Buddy – A Co-Working Experience establishes strong sustainability and accessibility that ensures immediate dissemination across various digital platforms. It is recommended that subsequent research and projects explore personalisation options more, such as adjustable work-to-break ratios or maybe the inclusion of motivational messages and their impact on different user demographics. Ultimately, Work Buddy – A Co-Working Experience serves as an impactful digital productivity tool that significantly enhances our work outcomes when dealing in isolated environments.

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Chapter 36

Perovskite Solar Cells for Energy Harvesting in Low-Light Environments

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ABSTRACT

The transition from fossil fuels to renewable energy is critical to reducing air pollution and mitigating climate change. Solar energy, as a clean and sustainable alternative, has gained significant attention, with perovskite solar cells emerging as a promising technology. These cells offer several advantages over traditional silicon-based photovoltaics, including higher efficiency potential, lower production costs, and simpler manufacturing processes. Recent research highlights the feasibility of perovskite solar cells for indoor and low-light energy harvesting, demonstrating their versatility beyond conventional outdoor applications. In this study, a solution-processed perovskite solar cell was fabricated and tested under room building light conditions. The device achieved an impressive open-circuit voltage of 1.49V and a short-circuit current density of 5.15 mA/cm², with a maximum power conversion efficiency of 18.67%. These results underscore the potential of perovskite solar cells to efficiently generate electricity even in ambient lighting, making them ideal for powering IoT devices, smart sensors, and other low-energy electronics indoors. The cost-effective production and high efficiency of perovskite solar cells position them as a key player in the renewable energy transition. Their ability to perform well under varied lighting conditions expands their applicability, supporting decentralized energy generation and reducing reliance on fossil fuels. Further advancements in stability and scalability could accelerate their commercialization, contributing to a more sustainable energy future. By harnessing indoor light, perovskite

technology complements traditional solar panels, enhancing energy accessibility and driving the shift toward cleaner power solutions.

Key Words: air pollution; solar cells; perovskite; efficiencies; ambient light.

1. INTRODUCTION

The increasing use of fossil fuels for power generation causes significant environmental, health, and social problems, necessitating cleaner alternatives. Burning them drives climate change, pollution, and land degradation with the Intergovernmental Panel on Climate Change (IPCC) urging immediate emission reductions. Fossil fuel plants release harmful pollutants, posing health risks. The limited supply also necessitates a shift to alternatives like solar energy. Solar power offers a clean, renewable solution that can significantly cut emissions and improve air quality. It has no toxic operational emissions and uses little water (Mehmood, 2021).

2. LITERATURE REVIEW

Traditional silicon solar cells work poorly indoors, limiting urban solar energy use. A study explores cost-effective perovskite cells for indoor electricity generation, using specific materials to boost low-light efficiency. Perovskites are a key advancement in affordable renewable energy (Yan et al., 2022), with solution processing showing high efficiency potential. Research aims to improve their efficiency, stability, and applications (Zhang et al., 2022), also using non-toxic materials (García-Mendoza et al., 2023).

3. METHODOLOGY

The perovskite solar cell production process starts with measuring 1.5 g of titanium dioxide (TiO_2) for the electron transport layer. TiO_2 is combined with polyethylene glycol (PEG) and ethanol to create a paste. The solution is deposited onto fluorine-doped tin oxide (FTO) glass (Figure 1), heated at 200°C for 10 minutes to form a strong TiO_2 layer. The glass then cools to room temperature, solidifying the TiO_2 layer.

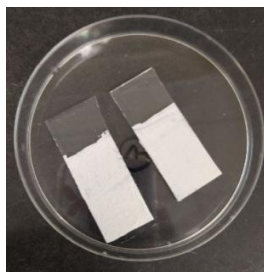


Figure 1: TiO_2 particles deposited on FTO glass.

The dye solution, prepared by mixing deionized water and nickel phthalocyanine-tetrasulfonic acid tetrasodium salt (NiTsPc), was applied to pre-coated FTO glass overnight (Figure 2).

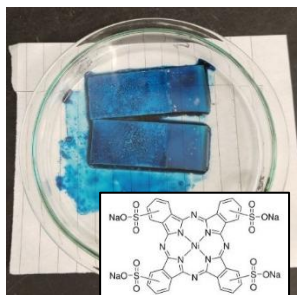


Figure 2: FTO coated glass with TiO_2 layer immersed in NiTsPc overnight (insert: NiTsPc molecular structure).

After long immersion, the FTO glass is removed from the solution, purified to enhance solar cell efficiency, and then annealed at 90°C for 20 minutes (Figure 3) until fully dry.



Figure 3: Annealing process of the FTO coated glass with TiO_2 and NiTsPc at 90°C .

In preparation for the counter electrode, another clean piece of FTO glass is applied with carbon paste to serve as the conductive layer that will facilitate electron collection. The FTO glass with carbon paste is then heated at 100°C for 10 minutes until dry.

Next, the process involves depositing iodine and perovskite solution onto TiO_2 surfaces, then attaching carbon paste-treated FTO glass. The assembled devices (Figure 4) are tested under low and high light intensity to evaluate their functional efficacy. The devices are connected to a source-measure unit to measure efficiency and general function.



Figure 4: The attachment of surfaces of TiO_2 , NiTsPc, iodine, and perovskite onto carbon paste-FTO coated glass.

4. RESULTS AND DISCUSSION

Figure 5 shows current density (J_{sc}) versus voltage (V) curves. Under low light, the maximum J_{sc} is 5.15 mA/cm² and the maximum open-circuit voltage (V_{oc}) is 1.49 V. Under 1 Sun intensity, the maximum J_{sc} is 8.3 mA/cm² and the maximum V_{oc} is 1.63 V. The curve's shape indicates the fill factor (FF), with a more rectangular shape signifying a higher FF. The observed linear slope suggests a lower FF, calculated using the FF formula (Equation 1) to be 0.29 under low light and 0.31 under 1 Sun intensity.

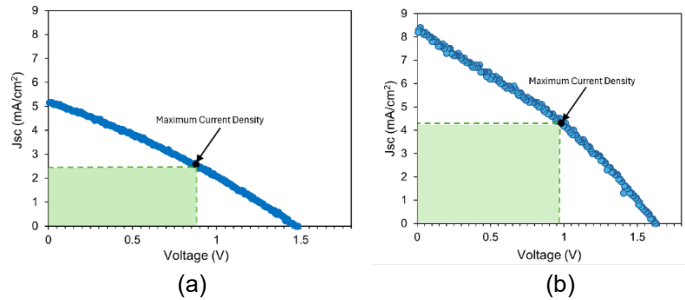


Figure 5: Current density versus voltage (a) under low-light intensity, and (b) under 1 Sun intensity.

$$FF = \frac{J_{max} \times V_{max}}{J_{sc} \times V_{oc}} \quad (1)$$

To quantify the solar cell's performance, we calculate the power conversion efficiency (PCE), which is given by Equation 2:

$$PCE = \frac{V_{oc} \times J_{sc} \times FF}{P_{in}} \times 100 \quad (2)$$

where V_{oc} is the open-circuit voltage, J_{sc} is the short circuit current density, FF is the fill factor, and P_{in} is the incident solar power (mW/cm²).

Figure 6 displays the power density versus voltage curve, derived from Figure 5, with its peak indicating the maximum power point (MPP) and the cell's highest electrical power output. The voltage at this peak is the maximum power point voltage (V_{max}), and the corresponding power value is the maximum power (P_{max}). Under low light intensity, V_{max} is 0.8 V, and the power output reaches about 2.24 mW/cm². Under 1 Sun intensity, V_{max} is 1.019 V, and the power output is approximately 4.21 mW/cm².

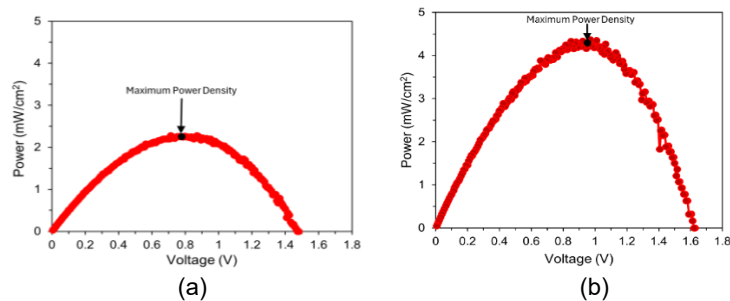


Figure 6: Power density versus voltage (a) under low-light intensity, and (b) under 1 Sun intensity.

The analyzed perovskite solar cell achieved a power conversion efficiency of 18.67% under low light intensity (10 - 12 mW/cm²) and 4.07% under 1 Sun intensity. The efficiency of these cells is highly dependent on the specific perovskite materials used, the fabrication methods employed, and the environmental conditions during testing.

5. CONCLUSION AND RECOMMENDATION

Solution-processed perovskite solar cells can generate energy under ambient light, achieving 1.49 V open-circuit voltage and 5.15 mA/cm² short-circuit current density. Power conversion efficiency reached 18.67% under low light and 4.07% under 1 Sun intensity, showing potential for indoor energy harvesting and sustainable energy. Future research should improve fill factor, explore materials and fabrication, and assess long-term stability.

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Chapter 37

VeloMove

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ABSTRACT

VeloMove is an innovative wheelchair designed to support individuals with disabilities in securing employment within the trade and logistics sectors, particularly in warehouses and airports. This project, developed under IBM554 – International Trade, explores how inclusive mobility solutions can contribute to workforce participation and global trade integration. The problem addressed is the lack of job opportunities for disabled people and lack of functional mobility equipment tailored for labor-intensive trade environments. We investigated the issue by distributing surveys and secondary research. VeloMove aims to solve this issue through its advanced innovation with steering, braking system, and detachable wagon feature—enabling users to safely and effectively handle goods in demanding settings. The objective of the project is to develop a product that increases inclusivity in job employment and improves technological inclusion. The materials and methods include the parts used and how to use VeloMove. Hence, VeloMove demonstrates the potential of inclusive innovation to drive economic participation and support international trade goals. It offers a meaningful solution that aligns with sustainable development and expands opportunities for a typically underserved workforce segment.

Key Words: VeloMove, international trade, inclusive innovation, technological inclusion, workforce accessibility

1. INTRODUCTION

During today's time, trade is a major part of everyone's lives. Efficiency and accessibility are a must in order to work in the trade sector. This makes job opportunities for disabled people ever more scarce as for example warehouses and airports have strict deadlines. As stated by (Pulrang, 2022) "the job gap between people with disabilities and without has always been enormous and any attempts to close it is not effective. This is due to the operational and infrastructure constraints that are faced when working in these fields. An innovative solution that we have come up with is called VeloMove. VeloMove is a wheelchair that pulls wagons that are attachable and detachable. This can allow them to work by bringing boxes in

warehouses or luggage in airports. With its state of the art technology this wheelchair can improve mobility, increase work speed and does not steer too far from the original process. The wheelchair also stresses comfort and safety. The problems that we found in order to make this innovation, the objective that we wish to achieve, the materials used and method of using this wheelchair, and the sketch of this product will all be discussed in more detail in the parts that follow.

2. PROBLEM STATEMENT

A lot of people with disabilities actually have the skills and motivation to work, but their chances are really limited because the equipment available just doesn't match the kind of physical work needed in places like airports, factories, or warehouses. The issue isn't their ability but it's the lack of proper tools to support them. Regular wheelchairs are fine for everyday stuff, but when it comes to jobs that involve carrying things, pushing trolleys, or moving quickly over long distances, they just don't cut it. But if companies could provide more advanced powered wheelchairs which are easier to control, can pull loads, and have storage space, it could open up a lot more opportunities and let them work just like anyone else.

3. OBJECTIVE

The development of the wheelchair could assist many disabled people with finding employment whether in international airports carrying luggage bags or in warehouses. With the help of assistive technology, such as sensors and cameras, allowing them to move things more efficiently. This advanced logistic technology which are the scanner, sensor, and tracking technologies was frequently used in worldwide logistics hubs and has the ability to export to other potential countries that are investing heavily in advanced technology trade services. This will benefit them in international trade agreements, as well as government contracts for assistive technology created from the unique wheelchair that not only assists disabled people, but also contributes to the country's economic trade.

4. COMMERCIALIZE POTENTIAL

This innovative wheelchair was limited because of the opportunities given to the company who were invested in global trade. The quality itself was at the greater that makes every company eager to purchase while it lasts. This excellent opportunity can help companies to improve its position in global trade by providing job chances for disabled people while also filling a labor shortage in areas such as airports, which require a large number of workers in order to operate. Obtaining government grants can make this product more affordable to sell. With the government incentives, production costs can be reduced, allowing businesses to focus more on providing affordable rates to customers while providing the high quality to the buyers. This benefited the buyer as they did not have to worry about legal requirements because the product has already received government grants. They can avoid legal penalties and fines by purchasing products that have previously received subsidies from the government. This product design was extremely efficient and specifically designed for the airport environment. With smart technology, which includes a scanner and a camera to monitor bags in and out, the labour of two people will be reduced to one. Using these tools

allows the company to minimize labour costs and operate more efficiently while increasing the total number of cargo loads in a day.

5. NOVELTY

A conventional luggage carrier train is very efficient and fast when transporting items and goods. Though it can only be used by the people who are able and qualified. Drawing inspiration from this and wanting to be more inclusive in the trade workplace, we have developed an innovative wheelchair that can help people with disabilities. This advanced wheelchair integrates cargo-carrying capabilities with assistive technology for latching and unlatching the cargo. Unlike normal wheelchairs and normal carrier trains, we have also added easy mobility and steering and even tools for parking, reversing and speed. This design was thought in mind for inclusivity and productivity, further empowering people with disabilities to help them gain more job opportunities in the trade sector. This is a first in the innovative trade sector as none have done this before. This innovation signifies a pivotal step toward a more equitable and accessible workforce in international trade.

6. BENEFIT TO COMMUNITY

When we give people with disabilities the right equipments like powered wheelchairs built for work we're not just helping them, we're also strengthening the whole community. More people working means fewer dependents and more income circulating in the economy. That benefits everyone. At the same time, we can lead in developing assistive technology, that's a real advantage. The world is paying more attention to inclusive practices. If our products meet those needs, we could become a known player in that space and that can boost our trade potential. Next, related to reputation as well. Countries and companies that treat workers fairly and support equal access are more respected in global trade. In fact, those values often show up in trade deals and partnerships. Most importantly, giving someone the chance to work changes their life. But it also helps their families and communities. They become more independent. Other than that, when they spend more, that spending helps local businesses. It's proof that inclusion isn't just the right thing to do it's also good for the economy.

7. FEEDBACK FROM COMMUNITY

A total of about 34 students responded to our study, which we have been conducting among UiTM students. All of them had to respond to it, nevertheless, taking into account the needs of current situations and the interests of disabled individuals who wanted to apply for jobs, particularly in the trade sector. It shows that only five minority respondents, however, believed that the working environments in airports and warehouses were accessible to people with disabilities. As for the remaining 27 respondents indicating that some workplaces are still thinking about including disabled people. This makes sense given that the airport and the warehouse were both busy spots. Meanwhile, it also shows that 28 of the 32 respondents cast a vote on the 4–5 scale. This clearly demonstrated that they admitted that our invention, VeloMove, could boost task performance. Furthermore, we designed this product with the intention of meeting users' expectations regarding comfort and safety. To sum up, the survey's findings indicate that the majority of respondents are aware of the value of our product

VeloMove for disabled people working in the trade industry. Investing in employment training and cutting-edge solutions like VeloMove can boost disabled people's participation in the trade sector and greatly increase productivity.

8. PRODUCT DESCRIPTION

Loading bags onto planes can be challenging. Bags get lost, misdirected, or damaged. Employees are handling heavy bags throughout the day, which is dangerous to them and takes a lot of time. When bags are loaded in an improper manner, the plane gets unbalanced. Lifting machines can harm the plane, and the moving vehicles burn fuel, which pollutes the air. Additional bags also weigh down the plane, so it uses more fuel. The VeloMove wheelchair allows individuals with disabilities to travel through airports without difficulties. It's made of tough, light material that won't rust. It has little carts for carrying bags, so one does not have to lift anything. The carts glide smoothly and quietly. The wheelchair has soft wheels and a waterproof, padded seat for comfort. It is driven by a quiet electric motor and is easy to drive with a remote. The buttons are easy to press, and the remote is Bluetooth-powered to control the wagons. It is recharged with a USB cable like a phone. The user operates it by sitting down, securing the belt, and switching it on. He/she operates it via the remote control and can switch it off for offloading packages. It can be recharged in the event of low battery. VeloMove enables airport travel with ease and autonomy for people with disabilities.

9. CONCLUSION

Many disabled people face employment issues due to the lack of tools and workspaces that cater towards their requirements. This is apparent in workplaces where mobility is important and equipment is scarce, such as warehouses and airports. We solved these issues with the creation of VeloMove. This innovative wheelchair can help disabled people carry out tasks with an attachable wagon and motorized wheelchair. We have made sure to balance the safety, comfort and functionality when creating VeloMove in order to maximize the workload. It is guaranteed that VeloMove is convenient whether traversing airport terminals or warehouse halls. This is due to the aluminum frame, plastic wagons, high-traction wheels, and strong battery. VeloMove is much more than a mobility device, it is a signal for change in the employment and accessibility of disabled people in trade workplaces.

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Chapter 38

ForkMatic (Automated Railed Forklift)

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ABSTRACT

The development of ForkMatic, an AI-powered rail-mounted autonomous forklift, addresses key challenges in warehouse operations by automating material handling tasks. Unlike traditional manual forklifts, ForkMatic enhances safety and productivity by minimizing human errors and reducing dependency on skilled operators. The system integrates seamlessly with Warehouse Management Systems (WMS) to provide real-time updates on inventory, improving stock tracking and order fulfillment times. With a focus on reducing labor costs, increasing operational efficiency, and ensuring precise material handling, ForkMatic is a scalable solution suitable for various sectors including logistics, retail, and healthcare. Its design prioritizes sustainability through the use of energy-efficient components and recyclable materials, making it an eco-friendly choice for modern warehouses.

Keywords: Autonomous forklift, warehouse automation, AI-powered systems, real-time inventory, Warehouse Management Systems.

1. INTRODUCTION

One of the greatest impacts of automation's growth is on warehouse and logistics management, which has changed the way many firms operate. To satisfy this growing demand, we are introducing ForkMatic, a brand-new AI-powered rail-mounted forklift solution. ForkMatic is a rail-mounted autonomous forklift truck equipped with an AI image scanner and video barcode for efficient item delivery, sorting, and detection. ForkMatic works freely, ensuring constant workflow, avoiding accidents, and significantly boosting output in contrast to conventional warehouse forklifts that are completely reliant on humans and prone to many input errors.

The product's business opportunity is huge. Because it is cost-effective and readily flexible with only little changes to the present structure, it is extremely suitable for third-party logistics as well as retail, healthcare, and manufacturing. This is particularly

relevant for strategically minded businesses, as this technology reduces the need for human labor, reduces the expenses associated with injuries, and improves production through value recovery. ForkMatic automated volumetric fork lifting and creates exact, safer, smarter, and more effective warehouses as businesses strive to modernize their businesses. This makes it intelligent, flexible, and forward compatible.

2. PROBLEM STATEMENT

As the global demand for faster and more reliable logistics increases, companies are constantly under increasing pressure to enhance their material handling systems. However, warehouse operators nowadays mostly operate manually that mainly cause inefficiency and safety risks in manual forklift operations. This creates a few issues that arise such as human error, slow operations and the safety of the workers. In response to that, accidents can occur easily due to misjudgement, which would lead to the goods getting damaged. Furthermore, constant readjustment and reliance on operator experience prolong loading and unloading times.

The second critical issue is the high dependence on skilled forklift operators, companies nowadays are dependent on their trained forklift operators in order to ensure that the goods supplied are safe and secured. This increases the demand for experienced operators, which not only raises labor costs as the constant need in having to hire new operators and training them is time consuming and requires a lot of resources that could damage the company's budget. Besides, this also creates problems during peak seasons and in situations where there is a shortage of trained staff.

3. OBJECTIVES

ForkMatic was created to overcome challenges in warehousing by automating repetitive tasks. With the growing importance of warehouses in logistics, ForkMatic helps improve operations, management, and adapts to industry needs. The goal of ForkMatic is to increase warehouse efficiency. Research by Sodiya et al. (2024) shows that automation systems reduce human errors, streamline processes, and improve time management. ForkMatic moves and organizes items faster and more accurately than manual methods (Chaudhari, 2019). It allows employees to focus on value-adding tasks, boosting productivity without overburdening workers.

ForkMatic also improves warehouse management with real-time inventory updates. It synchronizes with the central inventory system, reducing stock tracking errors (Jamil, 2025). The rise of e-commerce and demand for faster delivery drove the development of automation systems like ForkMatic. Raj & Thandayudhapani (2024) report that faster delivery expectations have increased pressure on logistics companies. ForkMatic operates 24/7 with high efficiency, reducing labor costs and speeding up material handling to meet e-commerce demands (Chaudhari, 2019).

4. PRODUCT DESCRIPTION

The Automated Rail-Based Forklift is an intelligent material handling device designed to operate along fixed rail tracks in industrial and warehouse settings. Its constrained movement along predetermined routes improves safety, reduces human errors, and boosts efficiency in densely packed storage areas. Equipped with sensors, automatic controls, and accurate navigation, the forklift ensures secure load handling, lowers the risk of collisions and unnecessary idling, and can seamlessly integrate with existing warehouse management systems. Perfect for repetitive transportation tasks, this technology offers a low-maintenance and dependable alternative to traditional free-moving forklifts.

5. NOVELTY

The rail-guided forklift is notable for its focus on energy efficiency, safety, and intelligent technology, all of which are adapted to the demands of contemporary warehouses. The use of path-guided rails, which keep the forklift on a predetermined path while minimizing mistakes and collisions and maximizing accuracy and navigation through sophisticated software and sensors, is what distinguishes it. Its sturdy, low-maintenance, puncture-resistant airless polyurethane tires allow for minimal downtime and maximum efficiency. Powered by a lithium-ion battery, it is less harmful to the environment, has a longer lifespan, and charges quickly. The system is adaptable and scalable, making it ideal for expanding companies or evolving warehouse designs.

Its intelligent control system makes it simple to integrate with warehouse management systems (WMS) and supports data-driven operations, real-time inventory tracking, and simultaneous task management. The forklift prioritizes sustainability and durability by using lightweight, recyclable, high-strength steel and aluminum alloys. It provides enhanced safety, control, and automation by doing away with free movement and emphasizing organized, optimized movement—particularly in high-call, critical operations.

6. FEEDBACK FROM COMMUNITY

The "INVENTOPIA 2025 – ForkMatic" survey aimed to quantify awareness and acceptability of warehouse automation, specifically ForkMatic. Completed via Google Forms, it used simple, multiple-choice questions in demographics, exposure to automation, and views on warehouse robots. Its readability guaranteed high response rates, simplicity of analysis, with results automatically compiled and exportable for research. Responses were guaranteed to be anonymous, providing honest feedback, and the survey was shared with a broad, diverse audience online.

Out of 36 respondents, 58.3% were female and 41.7% male, showing gender-diverse feedback. Most were familiar with automation: 52.8% somewhat, 38.9% very, and 2.8% experts, while only 5.6% were not familiar. Half believed automation often improves daily life, and 16.7% said it almost always does, reflecting a generally positive view. A large majority (91.7%) agreed that warehouses benefit from robotics, and 88.9% supported improved sorting and importing/exporting processes. Similarly, 88.9% saw

innovation in forklifts as important, and the same percentage believed ForkMatic could transform warehouse operations, indicating strong support for its potential.

7. POTENTIAL FOR COMMERCIALISATION

There is a growing global demand for new automation systems and logistics configurations, which greatly expands the commercialization possibilities for The ForkMatic system. ForkMatic needs to market itself as a fast and flexible solution for modern supply chains, and is battling ineffective business processes and people as they emerge. ForkMatic derives productivity benefits from "one" of real-time sorting, autonomous navigating, and AI controlled driving which can maximize operational efficiency for retailers, supplier manufacturers (medical), and logistics.

ForkMatic can also be implemented in large distribution centers but allows small-mid sized businesses to execute speed advantages due to its modular rail structure. ForkMatic provides long-term financial savings because of reduced wages based on the comparison of time to wage gulfs, risk cost eliminations of workplace accidents, and increases in productivity. ForkMatic is therefore a unique technological innovation and a commercially viable product that has a good chance of gaining popularity both domestically and abroad.

8. BENEFITS TO THE COMMUNITY

ForkMatic innovation system offers significant benefits to the community such as prioritising the workplace safety in material handling and logistics environments. As most warehousing operates theirs manually, ForkMatic design reduces the need for manual control which eliminates the chances of human error that could happen due to misjudgment and lack of attention when handling the products and services. This system lessens the physical closeness of the workers with the heavy machinery to avoid the accidents from happening.

Futhermore, ForkMatic innovation systems achieves a remarkable improvement in increasing the level of operational efficiency. The system enhances the adjustments of loading and unloading process automatically, by improving the speed of the process. This makes it more convenient to operate even during peak periods with minimal delivery time frames. Besides, the system provides valuable feedback that can further be used to analyze and optimize the productflow, warehouse layout, and task completion, and eventually resulting in more efficient and smoother operations.

9. CONCLUSION

ForkMatic Automated Railed Forklift solves modern warehousing problems through the application of AI and rail-guided navigation to improve efficiency, safety, and the lesser use of human labor. Autonomously operating, arranging goods, and monitoring inventory operations in real time would also seriously improve productivity during season-peak periods. According to a public opinion poll, ForkMatic and warehouse automation are widely accepted. ForkMatic is modular, sustainable, and system-compatible, and is already a proven scalable system and well-embedded in existing

operations, which makes it a solid investment in logistical, safety, and cost savings long term.

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Chapter 39

Soluxion Paint

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ABSTRACT

Soluxion Paint is a next-generation photovoltaic paint system designed to revolutionize the way industrial buildings harness solar energy. Soluxion Paint presents an innovative alternative to conventional solar panels by offering a lightweight, scalable, and easy-to-apply solution. This paint-based technology consists of a multi-layer structure including an internal insulation layer, a conductive base, a photovoltaic light-absorbing layer, and a weather-resistant transparent coating. As for the uniqueness of this innovative product, such a layer plays a crucial role in ensuring efficient energy conversion, temperature regulation, and long-term durability. The insulation component contributes to reducing heat gain, improving indoor comfort and lowering the energy demand for cooling systems such as air conditioners—especially crucial in warehouses storing temperature-sensitive goods. Additionally, the photovoltaic layer actively converts sunlight into electricity, supporting critical warehouse operations including conveyor belts, electric forklift charging stations, lighting systems, and automated machinery. Soluxion Paint not only simplifies the process of adopting renewable energy but also reduces maintenance costs and enhances aesthetic integration. The application process, using tools like airless spray systems, allows for uniform coverage on various surfaces without extensive modification to existing structures. In a market where sustainability, efficiency, and innovation are becoming essential, this product supports industries in achieving long-term energy goals and environmental compliance.

Key Words: Photovoltaic Paint, Renewable Energy, Industrial Innovation, Warehouse Sustainability, Solar Technology

1. INTRODUCTION

Warehouses are critical to the trade and supply chain industry but face increasing operational costs due to their high electricity consumption (Scullin, 2025). With recent hikes in electricity tariffs and growing pressure to adopt sustainable energy solutions, the need for cost-effective alternatives has become urgent. In response, we introduce Soluxion Paint, an innovative multi-layer photovoltaic paint designed specifically for industrial rooftops. This advanced solar solution featuring an insulation base, conductive

layer, photovoltaic coating, and weather-resistant top coat allows warehouses to generate clean energy directly from their roofs without structural modifications. Soluxion Paint offers a smart, scalable, and eco-friendly alternative to conventional solar panels, helping industries, reduce grid dependence, lower utility expenses, and support Malaysia's shift toward renewable energy.

The primary objective of this innovation is to make a significant advancement in the realm of renewable energy technology, how Soluxion Paint is an eco-friendly innovation compared to the common solar panels. Soluxion Paint is typically composed of less materials than traditional solar panels which require glass and metals that are hard to be disposed of and recycled when it's broken.

This initiative seeks to simplify and cost effective energy solutions. Since the installation of solar panels is quite complicated and includes the complexity of wiring, this innovation intends to achieve a product with the same function but more cheaper and easier. Recognizing the costs associated in traditional solar panel installation, this can lead to the more sustainable energy practices, promoting wider acceptance of solar solutions that are both cost effective and user friendly.

Ensuring both low maintenance and high efficiency, Soluxion Paint enables users to easily refresh its appearance. It allows for a straightforward touch up and maintenance which contributes to a more sustainable approach. Solar panels might need at least twice a year for cleaning activity while for Soluxion Paint has transparent layer coating to reduce the dust accumulation that blocks sunlight which leads to lower energy output.

The key issues identified is that warehouses use a significant amount of energy, which can significantly affect the operational cost and raise concerns about the sustainability goals for certain companies ("Effective Technologies and Practices for Reducing Pollution in Warehouses - a Review," 2023). In order to reduce the operational costs and improve electricity efficiency, switching to renewable energy like solar power can reduce greenhouse gas emissions and improve public health. However, solar panels have the complexity of wiring and are difficult to install and turn out to be more costly since it requires more employees to apply the technology (Maka & Alabid, 2022). Other than that, the way a technology gives a positive impact while it's in use does not always unveil the deeper implications. Disposing activity of any technology can also generate emissions since solar panels have a lot of components to separate in recycling processes (Singh, 2025). In response to these challenges, Soluxion Paint which is photovoltaic (PV) paint was developed to replace solar panels which give the same function and easier installation as it comes in the form of paint.

2. LITERATURE REVIEW

Traditional solar technologies, like rooftop photovoltaic (PV) panels, are widely used in industrial settings for electricity, offering strong return on investment (ROI) through reduced bills. However, their rigid silicon cells, glass encasings, metal mounts, and complex wiring lead to high installation costs, space limitations, and maintenance like manual cleaning. Conventional paint, used for decoration and protection with pigments, resins, solvents, and additives, lacks energy generation. Soluxion Paint, an emerging innovation, bridges this by embedding photovoltaics in a paintable medium. Its multi-layered system includes an internal insulation layer, a conductive base, a light-absorbing perovskite photovoltaic layer, and a transparent weather-resistant top coat. This lightweight and flexible composition is applied with standard spray systems, making it scalable to various rooftops. Unlike conventional panels, Soluxion Paint uses safer materials, avoids heavy metals, and has anti-dust properties for self-cleaning via rainwater, significantly reducing maintenance. This seamless blend of functionality, sustainability, and design flexibility positions Soluxion Paint as a novel solution for industrial-scale renewable energy integration.

3. METHODOLOGY

This section explains the step-by-step process of applying Soluxion Paint to a warehouse rooftop and how it converts solar energy into usable electricity for warehouse operations. Before any paint is applied,

the warehouse rooftop must be cleaned and ensured to be dry, smooth, and free from dust. A clean surface is crucial to ensure strong adhesion of the paint layers and to maintain uninterrupted electrical conductivity. Additionally, an embedded wiring system must be installed across the rooftop in advance. These wires will function as energy collection points and channel the electricity generated into the storage and distribution system.

Once the preparation is complete, the application of Soluxion Paint is carried out using an airless spray system ensuring an even distribution of each layer across the entire rooftop. The painting process begins with the application of the first layer—known as the conductive layer. This layer enables electric current to flow across the surface once the photovoltaic reaction occurs. Then, the second layer which is the photovoltaic (PV) paint layer is applied. This layer contains light-absorbing materials that activate the photovoltaic effect when exposed to sunlight. Sunlight excites electrons within the paint, generating electricity. Finally, a transparent weather-resistant coating is applied as the outermost layer. This protective layer ensures durability by shielding the photovoltaic paint from dust, rain, and UV rays.

After all the layers have been applied, the electrical system is tested to confirm that the current generated by the paint flows correctly through the wiring. Once verified, the electricity generated from the rooftop flows into a charge controller, typically using a Maximum Power Point Tracking (MPPT) system. This device regulates the electrical flow to ensure optimal energy efficiency and safe battery charging. From the controller, the current is stored in a battery system, which serves as a backup power source during periods without sunlight. The stored energy then flows into an inverter, which converts the direct current (DC) into alternating current (AC), making it usable for common electrical systems. From the inverter, the electricity passes through an Uninterruptible Power Supply (UPS), which provides backup during power outages and stabilizes the current. Finally, the converted and stabilized electricity is used to power essential warehouse systems such as HVAC units, lighting and automated conveyor belts. Through this integrated system, Soluxion Paint can generate clean energy and also supports full-scale warehouse operations.

4. RESULTS AND DISCUSSIONS

Our group has conducted a survey on x. 56 people carefully selected responses were analysed and the results as shown below.

Survey Questions	Responses	Discussion
Are you aware that solar energy is a renewable (reusable) energy source?	87.5% said yes, 7.1% were unsure	This strong level of awareness reflects a positive foundation for introducing solar-based innovations such as Soluxion Paint.
Do you believe that increasing public awareness of renewable energy can encourage more businesses to adopt sustainable practices?	92.9% agreed	It highlights that innovations like Soluxion Paint not only meet technical needs but can also benefit from growing public support for sustainability
4. Are you aware that many warehouses are transitioning to solar power systems to reduce energy costs and environmental impact?	64.4% said yes, 25% were unsure	This gap highlights the need for continued education and promotion of sustainable innovations like Soluxion Paint.
If you were a warehouse owner, would you consider it important to explore innovations beyond traditional solar panels to generate solar energy and remain competitive in a sustainable way?	100% agreed	Introducing alternatives like Soluxion Paint, which addresses the need for simpler, lighter, and more adaptable renewable energy solutions for industrial applications

If there were a new innovation such as <i>Soluxion Paint</i> , a paint that functions as an alternative to traditional solar panels by generating electricity when applied to rooftops, would you support its use?	98.2% agreed	It highlights the public's willingness to embrace innovations that can overcome the limitations of conventional solar panels, further validating the potential of <i>Soluxion Paint</i> as a practical and sustainable energy option for industrial and warehouse applications.

5. CONCLUSION

Soluxion Paint not only offers a new way to generate renewable energy but also serves as a practical solution to broader challenges faced by industrial areas, especially warehouses located near residential zones. By enabling warehouses to generate their own electricity, Soluxion Paint helps reduce dependency on the central power grid, ultimately easing pressure on the local energy supply during peak hours. This not only cuts down operational costs for businesses but also supports the stability of electricity in nearby rural communities, reducing the risk of power fluctuations and contributing to overall community well-being. In addition, Soluxion Paint stands out as a more affordable alternative compared to conventional solar technologies. While most solar solutions require expensive materials and complex installation, Soluxion Paint maintains a simpler process with minimal wiring, less labor and faster application making it especially suitable for small and economically disadvantaged businesses. This innovation aims to bridge the gap between sustainability and affordability, making renewable energy accessible to a wider market.

6. RECOMMENDATIONS

In light of the findings and the growing demand for sustainable alternatives in the energy sector, we recommend advancing the commercialization of Soluxion Paint, an advanced innovation of photovoltaic (PV) paint that is gaining attention in the renewable energy market. Propelled by the global shift towards sustainable energy solutions, this technology offers a transformative approach to solar energy integration. Unlike traditional solar panels, Soluxion Paint can be applied to various surfaces including rooftops and buildings of warehouses for large firms—turning them into clean energy generators. This versatility addresses the space constraints and aesthetic concerns associated with conventional solar installations. With an emphasis on paints that produce electricity from sunlight, the solar paint business is emerging as a new frontier in renewable energy. Photovoltaic (PV) properties found in Soluxion Paint enable surfaces to function like solar panels, offering creative ways to integrate renewable energy into buildings and infrastructure. According to WiseGuy Reports, although this technology is still in the research and development stage, it could eventually be widely adopted. Given these trends, our recommendation is to target large firms operating across industrial and commercial sectors, including multinational logistics companies, global manufacturing facilities, and expansive retail chains. The global integrated PV solar device market is expanding rapidly, supported by government incentives such as funding and subsidies (Maka & Alabid, 2022). While traditional solar remains less practical for many of these businesses due to high energy costs and structural limitations, Soluxion Paint offers a smart, accessible solution, allowing them to transform building surfaces into energy-generating assets without major infrastructure changes. To accelerate adoption, we suggest a strategic go-to-market approach including direct B2B outreach, partnerships with resellers, and potential licensing models. Demonstrating measurable energy savings and launching pilot programs with innovation-driven firms will build credibility and drive wider acceptance within this high-potential, underserved market. Thus, we recommend positioning Soluxion Paint as a key player in the global shift toward renewable energy, given its widespread applicability and alignment with sustainability policies and market demands.

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Chapter 40

TradeLens-XR

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ABSTRACT

TradeLens-XR is the cutting-edge AR-driven solution introduced here, which has the potential to revolutionize air cargo logistics to address critical issues such as cargo damage, communication barriers, safety risks, and handling inefficiencies due to manual processes. The solution combines AR with artificial intelligence (AI), thermal sensing, and contextual translation with AI to provide real-time tracking of cargo, damage detection, situational awareness, and language-based translation. These capabilities are integrated into a glasses-like, hands-free unit that enables air cargo crews to operate more efficiently and safely in dynamic, high-pressure environments. TradeLens-XR brings great benefits to the logistics industry and society as a whole with enhanced safety, reduced human error, improved traceability, and enabling of sustainable and efficient global trade operations. Business opportunities of the innovation across sectors like aircraft maintenance, security screening, emergency response, and infrastructure monitoring, thereby making it a common product for modern air cargo management.

Key Words: TradeLens-XR, logistics, air cargo, augmented reality (AR), artificial intelligence (AI), thermal imaging, scanner, translation

1. INTRODUCTION

Logistics is a critical component of international trade, facilitating the efficient movement of products across borders. Broadly defined, logistics encompasses supply chain and transportation management to ensure the timely and secure delivery of products. The expansion of the international trade industry has further amplified the importance of logistics as a foundational element of international trade. Traditionally, logistics is divided into two key categories: materials management and physical distribution. Materials management involves sourcing and purchasing raw materials, components, and finished goods (Jenkins, 2024), while physical distribution encompasses the handling, storage, and transportation of products. Critical logistics functions such as packaging, inventory control, warehousing and transportation are integral to physical distribution, ensuring products are efficiently managed

and delivered in optimal condition. Among the various transportation modes, air transport stands out for its ability to support fast and reliable delivery, particularly for high-value and time-sensitive products. However, despite its advantages, air cargo operations often face challenges related to real-time visibility, handling accuracy, and operational efficiency. In response to these challenges, there is an urgent need for innovation, not only to improve existing systems but also to transform the way logistics is managed and executed. Thus, TradeLens XR emerges as a forward-thinking application designed to meet these demands. Using cutting-edge AR technology, TradeLens XR aims to revolutionise cargo management by ensuring safer, faster, and smarter logistical operations in an increasingly interconnected world.

2. PROBLEM STATEMENT

In air cargo operations, efficiency, accuracy, and safety are non-negotiable factors in logistics management of international trade. Minor errors in the process can have serious consequences, including significant financial losses, shipment delays, or damaged high-value cargo. Human error or lack of visibility during loading and unloading activities are the main issues that contribute to cargo damage (iContainer, 2016). These issues are further exacerbated by inadequate monitoring systems that fail to provide real-time oversight, especially for temperature-sensitive goods such as pharmaceuticals, perishables, and fragile items (Gould et al., 2017). In the global air cargo environment, multilingual communication is an essential component. However, current machine translation tools often struggle with contextual accuracy, particularly in technical fields like logistics. According to Shahnazaryan et al. (2025), machine translations frequently misinterpret industry-specific terminology, leading to misunderstandings, incorrect instructions, operational delays, and even safety hazards. These challenges underscore the urgent need for an innovative, technology-driven solution that enhances visibility, minimises human error, and supports accurate cross-border communication. Therefore TradeLens-XR addresses this need by integrating augmented reality (AR) and context-aware communication tools into air cargo operations.

3. OBJECTIVES

The primary objective of TradeLens-XR is to enhance the safety, efficiency, and accuracy of air cargo operations by addressing the critical operational and procedural challenges faced by cargo crews and ground handling teams. These include issues such as cargo damage, language barriers, security threats and airport hazards (Gould et al., 2017). To achieve this, TradeLens-XR is designed with the following specific objectives.

3.1 To Improve Safety and Efficiency in Cargo Handling

TradeLens-XR enhances real-time cargo condition monitoring, damage prevention, and operational safety through augmented reality (AR) overlays and hands-free functionality, allowing crews to work more efficiently in high-risk environments.

3.2 To Enhance Communication and Decision-Making

By providing real-time, context-aware translation and AI-driven insights, the system reduces language-related misunderstandings and supports faster, more accurate decisions in international air cargo operations.

3.3 To Strengthen Cargo Visibility and Incident Response

TradeLens-XR enables cargo scanning and automated reporting, improving traceability, reducing delays, and accelerating responses to cargo-related incidents or irregularities.

4. NOVELTY

TradeLens-XR stands out with three key innovative features that directly support safer, smarter and more efficient air cargo handling.

4.1 AI Damage Detection

This feature uses artificial intelligence to detect cargo damage, both visible and hidden. It scans cargo surfaces in real-time and alerts users to any issues to help prevent losses and ensure better cargo care.

4.2 Thermal Imaging and AI Contextual Translation

TradeLens-XR includes built-in thermal imaging to detect heat levels in cargo. This helps identify temperature issues, which can warn users of fire risks or equipment malfunctions before they become serious problems. The translation tool allows users to instantly translate written text into their preferred language, directly through AR display. TradeLens-XR helps overcome language barriers during operations, reducing errors and improving communications among cargo management teams.

5. BENEFITS TO COMMUNITY

The TradeLens-XR innovation in air cargo logistics brings meaningful benefits to society by improving safety, efficiency, communication, and sustainability in cargo handling.

5.1 Improved safety and working conditions

TradeLens-XR enhances crew safety with hands-free AR technology, reducing risks in hazardous or tight spaces and helping prevent cargo damage and accidents.

5.2 Better communication and global collaboration

With real-time translation, the device breaks down language barriers in international teams, leading to fewer misunderstandings and smoother operations.

5.3 Greater efficiency and sustainability

By reducing manual errors, improving cargo tracking and supporting better decision-making. TradeLens-XR minimises waste, boosts productivity, and supports sustainable and efficient global trade.

6. COMMERCIALIZATION POTENTIAL

The commercialization potential of TradeLens XR in air cargo is significant, as it can benefit a wide range of stakeholders within the supply chain and logistics industry. TradeLens XR is a blockchain-based digital platform that enhances visibility, transparency, and efficiency across cargo movements. In the context of air cargo, it can be used by freight forwarders, airlines, customs authorities, ground handlers, and logistics companies to track shipments in real time, streamline documentation, and reduce delays caused by manual processes. With enhanced data sharing and secure, tamper-proof records, users can make faster decisions, improve coordination, and increase trust across partners. Furthermore, airports and cargo terminal operators can use the system to manage cargo flow more efficiently, reducing bottlenecks and improving service delivery. Overall, TradeLens XR's commercialization potential lies in its ability to connect all parties in the air cargo ecosystem through a single, reliable digital platform.

7. PRODUCT DESCRIPTIONS

7.1 Before innovation



Figure 1.0: Conventional head mounted display (HMD)

Figure 1.0 illustrates a conventional head-mounted display (HMD) equipped with core augmented reality (AR) features. These include a display or projection system, sensors, a microphone, and a camera. This standard AR device provides users with an interactive and immersive experience by overlaying virtual information onto real-world environments. It allows users to view the physical world while receiving computer-generated visuals and data in real time, from virtually any location.

7.2 After innovation

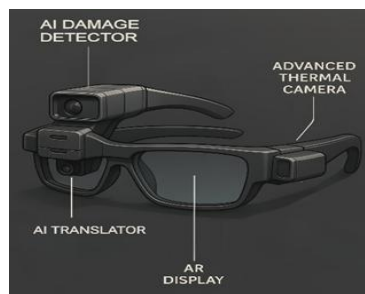


Figure 1.1: Innovation of TradeLens-XR

Figure 1.1 presents the TradeLens-XR, an enhanced AR wearable developed specifically for air cargo operations. The TradeLens-XR retains the basic features of the original HMD, including a display, sensors, microphone, and camera.

This innovative version introduces three significant upgrades which are advanced thermal imaging for detecting heat signatures in cargo, AI-powered damage detection to identify both visible and hidden cargo issues, and AI contextual translation to support real-time, accurate communication across languages.

8. CONCLUSION

TradeLens-XR is a smart and practical innovation in air cargo logistics. By combining AR, AI, thermal imaging, and real-time translation, it helps solve key challenges in cargo handling. The product improves safety, speeds up operations, and supports better communication and decision-making. It also promotes global teamwork and more accurate cargo tracking. Overall, TradeLens-XR sets the stage for a safer, faster, and more sustainable future in air cargo management.

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Chapter 41

Cultural Mapping, from Klang River transforming to be Muara Royale Restaurant

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ABSTRACT

This research focuses on cultural mapping in Klang, a historically rich and multicultural city in Malaysia, with the aim of identifying cultural assets and aesthetic values that can inform the conceptual development of Muara Royale, a tourism-oriented restaurant proposed at Wyndham Acmar Hotel. Klang's vibrant heritage, multicultural identity, and evolving urban landscape offer unique opportunities for creating a dining experience rooted in local culture and environmental awareness. A central aspect of the study is the Klang River, which flows through the heart of the city and has long played a vital role in shaping Klang's identity. In 2024, the river is undergoing a major rejuvenation initiative led by Landasan Lumayan Sdn Bhd (LLSB), focusing on sustainability and riverine cleanup. This transformation serves as both an environmental milestone and a source of design inspiration for the project. The restaurant's concept is built around the theme of *Bendalir*, a word that symbolizes fluidity and reflects the dynamic, ever-changing nature of water. *Bendalir* is interpreted through architectural and interior elements that mimic the graceful rhythms of the river, promoting a sense of continuity, harmony, and movement throughout the space. The design seeks to capture the calming yet powerful energy of flowing water, offering guests a tranquil atmosphere infused with cultural and ecological storytelling. Furthermore, the concept celebrates the biodiversity of the Klang River, acknowledging the cultural significance of water-based food traditions among the local community. By integrating nature, heritage, and gastronomy, this research proposes a dining experience that not only enhances Klang's tourism appeal but also strengthens appreciation for its environmental and cultural landscapes.

Key Words: Cultural mapping, biodiversity, conceptual, identity, sustainability

1. INTRODUCTION

Klang, a historically significant city in Selangor, Malaysia, is renowned for its multicultural fabric and riverside heritage. This study explores how cultural mapping can inform the conceptual design of Muara Royale, a tourism-oriented restaurant proposed at the Wyndham Acmar Hotel. The restaurant concept draws inspiration from Klang's ecological and cultural identity, particularly the Klang River, which has shaped the city's socio-economic and environmental history. The study aims to identify and integrate cultural assets into a spatial and culinary experience that promotes both heritage appreciation and environmental awareness.

A key development in Klang's environmental revitalisation is the rejuvenation of the Klang River, with significant efforts spearheaded by Landasan Lumayan Sdn Bhd (LLSB). In addition, international advocacy has added momentum to these efforts. In 2023, the British band Coldplay collaborated with the Malaysian non-profit organisation The Ocean Cleanup to deploy an Interceptor in the Klang River, aimed at reducing plastic waste before it enters the ocean (The Star, 2023). Such initiatives underscore the growing global recognition of Klang River's environmental value and inform the sustainability-driven concept behind Muara Royale.

2. LITERATURE REVIEW

Cultural mapping has emerged as a valuable tool in urban planning and place-making, enabling communities to identify and valorise their cultural and historical assets (Stevenson, 2014). It supports sustainable development by grounding tourism and urban projects in local identity. Klang's built environment and intangible cultural heritage—including religious diversity, food traditions, and vernacular architecture—offer rich material for place-based storytelling. River revitalisation efforts have increasingly influenced architectural and urban design narratives. The Klang River rejuvenation project, led by Landasan Lumayan Sdn Bhd (LLSB), focuses on restoring ecological balance and reconnecting people with their riverine environment (LLSB, 2023). Simultaneously, food heritage has been recognised as a powerful cultural marker, particularly in Malaysia's diverse ethnic landscape. Zainal Abidin et al. (2020) highlight the significance of traditional riverine recipes in reinforcing local identity and culinary sustainability.

Additionally, the integration of sustainable materials in design has become a growing trend within environmentally responsible architecture. Recycled plastic, particularly high-density polyethylene (HDPE), has demonstrated promise in furniture manufacturing for its strength, weather resistance, and recyclability. Sung et al. (2021) discuss the emergence of recycled plastic as a sustainable solution for design innovation in the context of a circular economy. Sustainability in furniture design emphasises low-impact materials, renewable resources, and efficient manufacturing techniques to reduce environmental harm (Fuad-Luke, 2009). Moreover, biodegradable, reclaimed, and rapidly renewable materials such as bamboo, cork, and bioplastics are increasingly explored in eco-conscious interiors (Chandrababu & Murthy, 2019). The concept of fluidity in architectural design has been notably explored by Zaha Hadid, whose work is characterised by organic, flowing forms that challenge conventional spatial boundaries. Hadid's designs often evoke the dynamics of water and natural landscapes, embodying a sense of movement and transformation

(Schumacher, 2010). This philosophy aligns with the *Bendalir* concept, providing a theoretical foundation for designing spaces that are both immersive and expressive of natural rhythm. This design approach also draws from the principles of Deconstructivism, an architectural movement that disrupts traditional geometry to reveal complexity and dynamic form. Architects such as Bernard Tschumi and Peter Eisenman used fragmented and non-linear compositions to challenge perceptions of space and flow, thereby complementing the notion of fluidity through architectural disjunction and reinterpretation (Wigley, 1988).

Prominent figures like Frank O. Gehry have also played a vital role in shaping the Deconstructivist movement. Gehry's projects, including the Guggenheim Museum in Bilbao, demonstrate the expressive potential of non-traditional materials and sculptural form. His architectural language embraces unpredictability and visual tension, embodying the deconstructed yet cohesive spirit that aligns with the fluid narrative envisioned in Muara Royale (Jodidio, 2009). When considered alongside Zaha Hadid's biomorphic forms, Gehry's fragmented compositions contribute to a broader framework of dynamic and responsive architectural expression. By merging Deconstructivist strategies with biomorphic inspiration, Muara Royale aims to produce a space that is simultaneously organic, poetic, and intellectually provocative.

3. METHODOLOGY

This study employs qualitative cultural mapping as its primary method, involving visual surveys, site observation, and the review of historical records, media, and local narratives. Cultural mapping was used to identify physical and intangible assets across Klang, including architectural motifs, traditional practices, and biodiversity linked to the Klang River. The findings were then translated into a design brief for Muara Royale, where the concept of *Bendalir* (fluidity) was selected to represent the evolving nature of water and culture. Architectural interpretation was guided by biomimicry principles, with a focus on the Klang River's natural flow, biodiversity, and symbolism. As part of the project's sustainable design strategy, materials research was conducted to explore the use of recycled plastic waste collected from the Klang River, particularly for crafting custom furniture. This approach not only supports environmental cleanup efforts but also contributes to circular economy practices in design. Local gastronomy research further informed the proposed menu and customer experience design, ensuring alignment between spatial design and culinary storytelling.

Additionally, case studies were reviewed to guide the conceptual development of Muara Royale. The Heydar Aliyev Center by Zaha Hadid exemplifies fluidity in form through seamless curves and organic transitions, aligning with the *Bendalir* ethos. In terms of sustainable dining spaces, Silo in London serves as a zero-waste restaurant that uses recycled materials in its interiors, including furniture made from upcycled plastic and

compressed food packaging. These cases informed both the spatial fluidity and sustainable material strategies adopted in the project

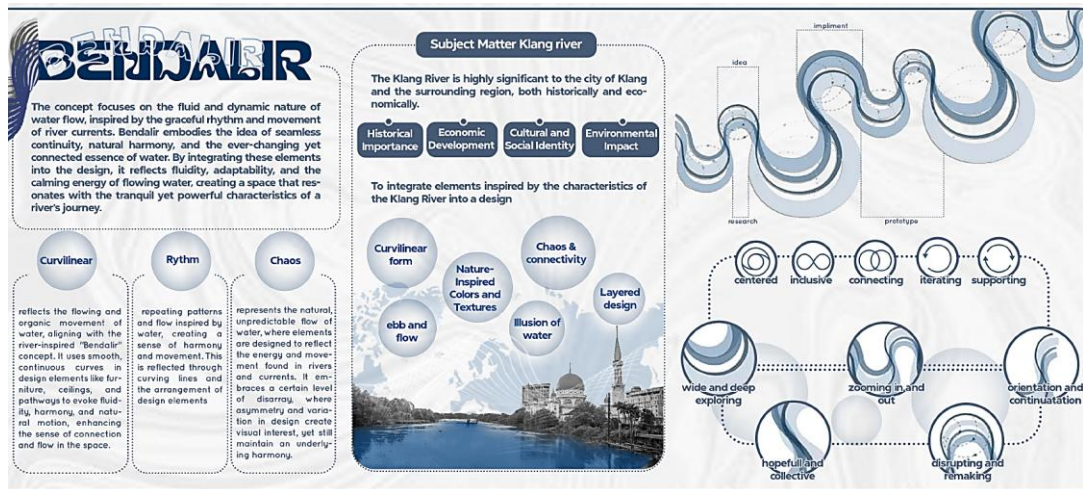


Figure 1: Conceptual Development for Muara Royale Restaurant

4. RESULTS & DISCUSSION

The cultural mapping revealed a strong connection between the Klang River and local cultural identity. Heritage buildings, waterfront temples, and long-standing food stalls near the river reinforce the significance of this natural element. The concept of *Bendalir* was developed to embody fluidity, reflecting both environmental rhythms and cultural transitions. The restaurant's proposed layout features curvilinear forms and materials inspired by riverine textures—such as flowing wood grains and reflective surfaces—to evoke a sense of movement. Interior spaces are arranged to simulate a continuous flow, encouraging a calm and immersive experience. Water-themed elements are integrated without literal replication, maintaining subtlety and elegance.

A key innovation in the design is the use of recycled plastic waste retrieved from the Klang River in the fabrication of furniture and interior elements. Custom-designed chairs and tables incorporate this upcycled material, creating a unique visual language that ties back to the project's ecological theme. This strategy not only showcases environmental stewardship but also raises awareness among visitors about river pollution and the importance of sustainable practices. The integration of waste materials into high-end dining spaces challenges traditional perceptions of value and aesthetics in interior design. Research shows that recycled plastic, when properly processed, offers structural durability and aesthetic versatility, making it suitable for sustainable furniture design (Sung et al., 2021).

Culinary offerings are designed to highlight the biodiversity of the river, with an emphasis on traditional Malay, Chinese, and Indian recipes that use freshwater ingredients. Dishes like *asam pedas ikan sungai* and herbal soups demonstrate the project's commitment

to culinary heritage. This integration of design, nature, and food supports Klang's cultural tourism goals while addressing environmental sustainability.

5. CONCLUSIONS & RECOMMENDATION

This research demonstrates that cultural mapping can be a vital tool in shaping meaningful, sustainable tourism experiences. The Muara Royale concept, rooted in Klang's riverine identity and expressed through the theme of *Bendalir*, offers a model for how design and gastronomy can reflect and reinforce cultural narratives. The incorporation of ecological and heritage elements fosters a sense of place, which is increasingly valuable in a globalised tourism market.

One of the project's key innovations—the use of recycled plastic waste from the Klang River in furniture design—illustrates how creative design practices can directly contribute to environmental restoration and awareness. It exemplifies how circular design thinking can be embedded in tourism development without compromising aesthetics or user experience.

It is recommended that similar projects engage in thorough cultural mapping at the early stages of design to ensure authenticity and relevance. Future research should include community engagement to further validate and enrich the cultural narratives incorporated into design proposals. Additionally, collaborations with environmental agencies and recycling initiatives are encouraged to enhance the impact of sustainable materials in design innovation.

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Chapter 42

HibisTrade Application

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ABSTRACT

HibisTrade is an innovative digital application designed to address challenges in navigating complex regulations, managing logistics, and ensuring compliance in the international trade environment. The application helps users, especially businesses, stay compliant with evolving international regulations, including tariff classification, documentation standards, and sustainability requirements under the ESG framework. HibisTrade enables its users to better understand and control logistics management to avoid overstocking or stockouts. Additionally, the application offers practical support to help SMEs enter international markets.

Key Words: Trade Compliance, Digital Customs Management, Logistics Optimization, SME Export Support, AI-Driven Trade Solutions.

1. INTRODUCTION

Globalisation and international trade have become increasingly significant in today's interconnected world. The global economy has undergone a remarkable transformation as countries grow more interconnected, driven by technology, communication, and transportation (ResearchFDI, 2024). These developments have not only connected markets more closely but have also opened up new opportunities for business development across borders. The reduction of trade barriers such as tariffs and quotas has made it easier for businesses to expand internationally and reach broader consumer markets. This shift has resulted in global competition spurring innovation and delivering benefits to both producers and consumers alike (ResearchFDI, 2024).

In this evolving global trade environment, HibisTrade contributes by offering a practical digital platform that supports businesses in managing customs procedures and cross-border logistics more efficiently. The platform is designed to simplify exporting processes by addressing key challenges such as tariffs, compliance requirements, and logistics coordination.

2. PROBLEM STATEMENT

In today's complex and fast-changing international trade environment, businesses engaged in import and export face increasingly strict regulatory requirements. Navigating these challenges demands strong and consistent compliance systems. However, many organisations still rely on fragmented processes, which often lead to inefficiencies, regulatory risks, and reduced competitiveness. Existing compliance systems frequently struggle to consolidate critical data from multiple sources. This makes it difficult to access compliance requirements accurately and increases the risk of reporting errors. This is supported by Yamaura and Xia (2015), who note that managing large volumes of regulatory information can be overwhelming, particularly when using disconnected platforms. Furthermore, without a clear and centralised view of compliance status, companies may face delays in decision-making, missed opportunities, and unintended non-compliance (Nickkar and Lee, 2022). The need to navigate multiple systems for compliance data and market analysis adds further complexity and increases the potential for human error during data transfer. Moreover, when competitive intelligence tools operate independently of compliance systems, businesses may pursue market strategies that unintentionally breach regulatory standards, leading to financial and legal consequences (Chen et al., 2022; Zainal et al., 2021). To address these challenges, there is a clear need for an integrated platform that combines trade compliance functions with real-time market analysis. Such a solution can help businesses operate more efficiently, make informed decisions, and reduce compliance risks in a globalised trading environment.

3. OBJECTIVES

HibisTrade aims to provide a smart, user-friendly platform that helps businesses manage the export process more easily and efficiently. It addresses common challenges in international trade, such as tariffs, customs duties, and regulatory compliance by centralising key trade information, including export laws, tax policies, and documentation requirements (Hodder, 2024). The platform also integrates practical tools for inventory management, order tracking, and fulfilment. By bringing these features together, HibisTrade supports better decision-making, reduces operational risks, and enables businesses to expand smoothly into global markets through technology-driven solutions.

4. COMMERCIALIZATION POTENTIAL

HibisTrade demonstrates strong potential for commercialization, driven by the growing demand for modern and digital solutions in international trade management. As international supply chains become more complex and regulatory requirements continue to tighten, businesses like small and medium enterprises (SMEs) are under increasing pressure to maintain compliance while staying competitive. According to Technavio (n.d.), the global trade management (GTM) software market is expected to grow by USD 1.12 billion between 2024

and 2028, fueled by demand for streamlined operations and targeted feature enhancements. This growing market highlights a clear opportunity for HibisTrade to position itself as a valuable solution, especially in helping SMEs adapt to ever-changing trade laws and business environments

5. NOVELTY

HibisTrade offers a fresh and practical approach to modern international trade management by applying simplified procedures, customized operations, and efficient regulatory compliance in one platform. Navigating challenges in international trade through the use of tools such as artificial intelligence and digital customs software enables better accuracy in documentation, cost savings, and greater efficiency, which are critical in today's evolving trade environment (Fuller, 2024). Through innovative tools like predictive risk analysis and automated document verifications, HibisTrade supports smarter, faster, and adaptive decision-making. These elements align with current industry demand, where businesses are turning to technology to build more responsive and resilient supply chains in the face of regulatory and geopolitical changes (The Economist Group et al., 2024). Thus, HibisTrade's innovation lies in offering businesses the right tools to stay compliant, competitive, and ready for global growth.

6. BENEFITS TO COMMUNITY

HibisTrade benefits the company and society. HibisTrade gives companies clear, concise customs and rule overviews. This lets companies transport worldwide without errors that could delay or fine them. Thus, everything works well, and cooperation improves. Nguyen et al. (2019b) show that good customs communication and education reduce border difficulties and boost cooperation. TradeSphere saves time and money while helping firms comply with the law. Furthermore, HibisTrade uses smart technologies to improve logistics and shipping management for enterprises. Orders can be filled and shipped faster and more accurately. It also helps companies decide whether to order current goods by showing them inventory levels in real time. This prevents them from running out or having too much while silent.

Effective transportation and inventory control reduce corporate costs and improve customer satisfaction (DaphnePanchak, 2024). Knowing commodities' tax and tariff rates is crucial for global trade. HibisTrade helps companies identify their goods and calculate tariffs using international codes. The tariff must be precise to avoid delays or extra fees. Researchers say businesses might avoid customs issues and better plan budgets by precisely identifying their commodities (Guanjianyu, 2024). Next, small and new enterprises find it difficult to expand abroad. Shipping methods and criteria are complicated. HibisTrade provides precise instructions and tools to manage logistics and support these activities. Exporting costs less and takes less time. The research found that smaller companies with easier access to shipping support and regulatory information can succeed in new markets (Podosynnikov et al., 2024).

7. FEEDBACK FROM COMMUNITY

Based on the feedback from the community, the unanimous agreement highlights a clear and urgent need for improved tools in the international trade industry. The strong interest in HibisTrade confirms its relevance and potential value, as users recognize the importance of an all-in-one solution that combines trade compliance and market analysis tools to support more efficient, accurate, and strategic global trade operations.

QUESTIONS	YES	NO
Do you often deal with import or export activities?	83.3%	16.7%
Do you often need to check trade regulations when entering new markets?	77.8%	22.2%
Have you used any tools to enter new market such as trade compliance tools and market analysis tools before?	72.2%	27.8%
Do you use more than one app or website to get trade and market information?	72.2%	27.8%
Have you ever delayed a business decision due to unclear compliance rules or market data?	88.9%	11.1%
Is saving time on compliance and research a priority for your business?	83.3%	16.7%
Do you think there's a need for better tools in the import/export industry?	100%	0%
Would using one app instead of many make your work easier, save you time and effort?	94.4%	5.6%
Would you be interested in trying HibisTrade, an application with complete features of trade compliance tools and market analysis tools?	100%	0%

8. PRODUCT DESCRIPTIONS

a. Launch the app

From your desktop or mobile device, launch the HibisTrade app. Enter your registered business credentials to log in. If you're a new user, fill out the short registration form by entering your business information and setting a password.

b. Get started

On the home screen, the user taps the prominent "Get Started" prompt to begin exploring export options and tools. Users can access:

- Shipping rules and regulations
- Market Analysis

c. Choose export destination for shipping rules

User selects a target region from the list or search bar. Then select a country. All relevant information about shipping rules, regulations, required documents, and trade policies for exporting to that region.

d. Choose country for market analysis

Users select a target region from the list or search bar. Then select a country. Users can search all the data about recent news, product demand, competitor landscape, pricing benchmarks, and import trends for the selected country.

9. CONCLUSION

HibisTrade represents a meaningful step towards digital international trade management. By combining technologies and user-friendly interfaces, it offers simplified trade processes. The application is valuable for businesses, especially small and medium companies seeking to expand globally with fewer barriers and lower costs. Provided with current market needs and future trend analysis, HibisTrade contributes to a more efficient, inclusive and resilient international trading ecosystem. With its wide-ranging functions, HibisTrade not only eases compliance but also improves interaction between businesses and their users, facilitating international trade that is sustainable and efficient.

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Chapter 43

Thermomate: Bringing A New Concept in Portable Beverage Temperature Solutions to the Market

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ABSTRACT

In the fast-paced and convenience-driven environment of college life, students often face difficulties in accessing beverages at their desired temperatures due to limited facilities in dormitories and academic buildings. Thermomate is a conceptual solution that addresses this problem by offering a portable, smart tumbler capable of both heating and cooling drinks. This study explores the idea development of Thermomate using a conceptual methodology, based on logical reasoning, creativity, and existing technologies such as thermoelectric modules. Through analysis of student needs and limitations of current solutions, the proposed tumbler stands out for its practicality, portability, and potential to support hydration and well-being among students. While still in its ideation phase, Thermomate presents a compelling opportunity for future product development and commercialization aimed at improving daily convenience and health habits for students and other users in mobile lifestyles.

Key Words: Smart tumbler, Thermoelectric technology, Student lifestyle, Portable beverage container, Hydration solution.

1. INTRODUCTION

The bustling and often chaotic environment of college dorms, where convenience and time are precious commodities, satisfying a simple craving for a hot or cold beverage can quickly transform into an inconvenient and even frustrating ordeal. Students are frequently confronted with long journeys to distant water dispensers or malfunctioning elevators that make getting

drinks up and down many steps of stairs a tiring work. Furthermore, many dorms do not have adequate conveniences for keeping the correct temperature of drinks throughout the day. A hot coffee can cool down before you get to class, while a cold drink can heat up way too rapidly in the dorm room.

Thermomate is an ideal answer for tackling the daily issues that many students confront. Thermomate provides a clever, portable, and incredibly efficient drink temperature management solution that blends in perfectly with the hectic lifestyle of contemporary college students. It is portable, simple to use, and easy to maintain, allowing students to enjoy their drinks for hours on end at the ideal temperature, whether they like them steaming hot or cool. For students who wish to optimize their time and minimize disturbances to their routine, the ease of a smart, portable drinking container that adapts to your needs makes it an essential tool.

Thermomate stylish and useful design makes it unnecessary to make several trips to the water dispensers. Thermomate makes sure that your drink stays at the perfect temperature without requiring any additional effort, whether you're working late into the night, hurrying to an early class, or just chilling in your college room. The ease of owning a portable, smart tumblethat adapts to your needs makes it an essential tool for students looking to maximize their time and avoid disturbances to their routine.

2. LITERATURE REVIEW

Drinking at the right temperature is crucial for many people, ranging from the student to the office worker and even the traveler. It enhances your comfort, productivity, and overall well-being. But refrigerators or hot water dispensers, for that matter are not everywhere, especially for students living in dorms. This leads to a demand for beverage containers that can maintain temperatures.

Now studies confirm that beverage temperature affects both personal mood and mental performance skills. Drinking cold beverages preserves bodily hydration levels and this supports maximum cognitive performance. Enhanced mental focus together with better attention results from proper hydration especially during hot weather which dehydrates the mind (Saftarina & Fauziah, 2023). Hot beverages including tea and coffee create relaxation while offering comfort to users. Hot beverages create feelings of relaxation through their warmth thus they provide stress-reduction benefits in demanding moments like testing or moving between locations (Mentes et al., 2019). Hot beverage consumption leads to increased comfort feelings based on scientific evidence which supports both emotional state and brain processing capabilities (Aung et al., 2023).

Refrigerators, thermos flasks, and electric dispensers all have some limitation, they either cost too much, are typically bulky, or even totally banned in dorms. Newer options, such as vacuum-insulated bottles, may heat or cool, but rarely do both at a fairly reasonable price, and it is often heavy. ThermoMate has come out with a more affordable, stylish, and portable bottle, heating, and cooling beverages for students and travelers and office workers so they can have convenience wherever they go.

3. METHODOLOGY

This research is fully based on thinking and idea development without using any case studies or data collection. The approach is conceptual in which the main focus is to explore and develop the idea of a self heating and self cooling tumbler using logic, creativity, and general knowledge from existing tumblers. There is no experiments or surveys were done for this research.

The process started by identifying common problems people face when using normal tumblers without any add-on feature. For instance drinks getting cold too fast or being too hot to drink. The idea of smart temperature control was explored using simple reasoning. The concept involves combining heating and cooling functions in one tumbler using technology that already exists, such as thermoelectric elements (like Peltier modules) and rechargeable batteries.

Instead of studying actual products, the idea was imagined by the team members and improved step by step by thinking about how it would work in real life. For example, how the user would turn it on, how long the battery would last, or how safe it would be. Basic features like portability, button control, safety, and user convenience were also considered as part of the design idea.

Since this is only a conceptual research, the purpose is not to prove whether the product can be built right now. However, to show that it is an interesting and useful idea that could be developed further in the future.

4. DISCUSSION & RESULT

The Thermomate tumbler is one of the useful and practical solutions especially for students who live in college and face long days of learning classes. Since they are not allowed to bring personal appliances such as kettles and mini-fridges, they also are not provided, only relying on water dispensers that are located quite far from students' residences and lecture halls. Because of that, many students face difficulties getting hot or cold water during the day. Based on the problems, Thermomate is designed to solve the issues by keeping hot or cold water for a long period of time, allowing students to enjoy their drinks anytime without having to move from their study space.

This product idea deserves attention because it is portable, easy to use and ensures student's health is more awake by encouraging them to drink more water according to the proper amount. It also will help students to save the time and their money pocket from buying drinks from the outside. However, to make sure this product works properly in real-life situations, prototyping and testing are required since this idea is still in the conceptual stage.

5. CONCLUSION & RECOMMENDATIONS

In conclusion, the Thermomate tumbler is a smart and practical solution to a common problem faced by students, especially those living in dorms or spending long hours on campus. Without easy access to kettles or fridges, students often struggle to get hot or cold drinks, especially when water dispensers are far from hostels or classrooms. This can lead to dehydration and affect their focus in class. Thermomate addresses this issue by allowing users to heat or cool drinks anytime, anywhere, just like a portable kettle and fridge. Lightweight, user-friendly, and

easy to carry, it fits perfectly into the busy lifestyle of students and encourages hydration while saving money on outside drinks.

To move forward, a prototype should be developed and tested among students in real-life situations such as during classes or outdoor activities. Their feedback on performance, comfort, and usability will help improve the product. After refinement, a business plan can be created to launch the tumbler through campus shops, events, or online platforms. If successful, the product can expand to other markets like office workers or travelers. With proper development and promotion, Thermomate has strong potential to improve everyday life for students and beyond.

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Chapter 44

Ex-Zier

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ABSTRACT

Ex-Zier is an innovative web-based platform designed to simplify and streamline export pricing. It addresses common challenges faced by exporters, small businesses, and students by offering real-time exchange rate integration, automated pricing calculations, and mobile-friendly access all in one user-friendly platform. Unlike many existing tools that are overly complex or fragmented, Ex-Zier combines key pricing components such as currency conversion, shipping costs, and estimated taxes into a single solution, reducing manual effort and pricing errors. The platform is especially valuable for small businesses and exporters operating across multiple countries, where fluctuating exchange rates and varying trade regulations often complicate pricing. With Ex-Zier, users can generate accurate and up-to-date export prices instantly, helping them remain competitive in the global market. In addition to its practical applications, Ex-Zier serves as a powerful educational tool. It helps international trade and business students apply classroom theory to real-world scenarios, deepening their understanding of global pricing strategies, cost structures, and cross-border logistics. Aspiring entrepreneurs and individuals unfamiliar with export procedures can also use the platform to gain insight into international trade, making global commerce more accessible and less intimidating. The novelty of Ex-Zier lies in the integration of essential export tools with a clean, mobile-optimized interface and real-time data. Its clear design and customizable features improve user engagement and efficiency, while its educational value supports future industry professionals. With a clear target market, strong commercialization potential, and community-focused benefits, Ex-Zier stands out as a smart, comprehensive solution that transforms how users approach export pricing in today's fast-moving global economy.

Key Words: Ex-Zier, international trade, international business, exchange rate, logistic efficiency.

1. INTRODUCTION

In the dynamic landscape of today's global economy, pricing plays an important role in shaping a company's competitive position. While setting domestic prices is already a strategic task, determining export prices introduces complexity (Seyoum, 2021). Businesses, especially SMEs and aspiring entrepreneurs, might struggle with manual calculations and currency conversion, leading to inaccurate pricing costs. Additionally, international considerations, such as shipping costs, customs duties, and taxes, further complicate pricing decisions. This complexity highlights the need for practical tools that simplify pricing methods. Ex-Zier was developed to meet this need. It is an online tool for converting export prices that brings all key pricing components into one platform. By offering accurate and comprehensive export pricing estimates, Ex-Zier helps users avoid costly mistakes, make informed decisions, and improve their competitiveness in international markets.

2. PROBLEM STATEMENT

In today's global trading environment, exporters frequently rely on online tools to calculate export prices. However, many existing platforms fall short of meeting the practical needs of exporters (Andrea Fracasso, 2021). Users often must manually input critical financial data such as freight charges, customs duties, and exchange rates due to a lack of automation and real-time data integration. This increases the risk of human error and leads to inaccurate cost estimates, and potential loss of profit (Andrea Fracasso, 2021). Additionally, exporters typically adopt pricing strategies that go beyond simple currency conversion, aiming to remain competitive and profitable in diverse markets. This makes it difficult to predict product prices in foreign countries based solely on exchange rate fluctuations. Such limitations also affect students and researchers who rely on these platforms for academic purposes, as they miss out on the practical understanding of how real-world pricing, exchange rates, and compliance issues intersect. It empowers exporters with accurate, efficient, and strategic pricing tools while also enhancing the learning for students by bridging the gap between theory and practice in international trade.

3. OBJECTIVES

The primary goal behind developing Ex-Zier was to simplify and enhance the accuracy of export pricing. As an all-in-one online platform, Ex-Zier allows users to quickly calculate export prices with the added flexibility of converting results into different currencies, theoretical knowledge and real-world application in international trade.

3.1 Enhance accuracy and efficiency in export pricing

The goal is to provide users with real-time exchange rates and automated pricing calculations, which eliminate manual errors and outdated data.

3.2 Support global competitiveness

To enable businesses to make informed pricing decisions in response to currency fluctuations, helping them stay competitive in international markets.

3.3 Facilitate learning and accessibility

This is to serve as an educational tool for students and a practical resource for small businesses and exporters by simplifying complex pricing components in a user-friendly interface.

4. NOVELTY

Ex-Zier introduces an innovative and user-friendly solution for managing export price conversions, addressing common pain points in existing tools. Many export pricing platforms are cluttered and difficult to navigate, which discourages users and reduces efficiency. Ex-Zier solves such an issue by offering a clean, intuitive interface that brings all essential tools into one place. The platform avoids unnecessary complexity and simplified and user-centered design making it easy for users to find what they need quickly without feeling overwhelmed.

With the rise of mobile browsing, a responsive and mobile-friendly interface is essential. Ex-Zier is fully optimized for smartphones and tablets, allowing users to access and use the platform seamlessly on any device. Ex-Zier streamlines export price calculations by offering real-time currency conversion rate integration. Users can simply enter the value of goods, select shipping terms, and choose the target currency. The system instantly calculates the final price using up-to-date exchange rates, eliminating the need to visit multiple websites or manually track currency trends.

5. COMMERCIALIZATION POTENTIAL

The possibility for the candidate technology to be commercialized is known as commercial potential (Bandarian, 2007). Ex-Zier offers a strong commercial opportunity and its core strength lies in understanding and directly serving its most relevant users. The primary target market for Ex-Zier includes small businesses, exporters, and international student groups that often face challenges in navigating export pricing due to complex calculations, currency fluctuations, and inconsistent tools. Small businesses typically lack the time or resources to manage export pricing efficiently. This helps exporters in different countries facing shifting exchange rates and shipping costs to stay competitive with up-to-date and accurate data. Moreover, International students can benefit from Ex-Zier's practical with real-world application. This clarity in its market focus significantly boosts its commercialization potential.

6. BENEFITS TO COMMUNITY

Ex-Zier supports students in international trade and business by turning the theory into practice in real-world scenarios with real-time export prices, logistics options, and currency exchange rates. This hands-on experience strengthens their understanding of global trade, strengthens their market analysis skills, and better prepares them for professional careers

(Andrade-Silva et al., 2023). Secondly, for individuals new to exporting, such as aspiring entrepreneurs, Ex-Zier helps them as users make informed decisions when entering foreign markets by providing transparency into global pricing, taxes, and transportation methods. It reduces the confusion and hesitation many feel when considering international trade, making the global marketplace more accessible and less intimidating.

Thirdly, Ex-Zier allows small and medium-sized businesses to calculate export prices accurately using real-time data, select cost-effective shipping options, and ensure tax and regulatory compliance. These features help businesses reduce costs, improve logistics, and avoid legal risks while strengthening their position in competitive international markets (Crivva, n.d.).

7. FEEDBACK FROM COMMUNITY

According to the survey results, majority of respondents (76.7%) struggled with manually setting export prices, highlighting the need for a real-time pricing tool. Furthermore, all respondents (100%) recognised the value of real-time export data, prioritising solution websites such as Ex-Zier. Websites were considered an attractive and practical tool for accessing export-related information, with 93.3% of respondents expressing interest in platforms that offered integrated features such as price and tax data. All respondents agreed that Ex-Zier was a very beneficial tool for improving decision-making, reducing errors and costs, and increasing efficiency in international trade.

Table 1: Results from Community Feedback

QUESTIONS	YES	NO
Do you often struggle to determine export prices manually for other countries?	76.7%	23.3%
Is it important for you to get real-time export price information?	100%	
Do you think using a digital app is an engaging and effective way to access vital information such as export prices, shipment options, taxes, and global exchange rates?	100%	
If there is a website like Ex-Zier that allows you to check real-time export prices, choose shipping methods and view tax regulations for different countries; all in one place, would you use it?	93.3%	6.7%
Would you agree that a website like Ex-Zier can streamline export trade by providing accurate and up-to-date information for better decision-making?	100%	

8. PRODUCT DESCRIPTIONS

1. Visit the Homepage
 - Access a clean, modern layout with easy navigation.
 - Tabs inside include Features, Pricing, FAQ, and Login.
2. Log In to stay Updated
 - Create an account or log in to stay informed about updates and access all features.
3. Click “Get Started”
 - Use the bold Get Started button to begin exploring Ex-Zier’s main tools.

4. Explore the Export Converter
 - Simplified currency conversions and export pricing
 - Clicking on it reveals detailed services
5. Use the Documentation Tool
 - Easily prepare and manage all export-import paperwork
6. Access the customs Feature
 - Get simple guidance on rules and regulations for international trade.
7. Navigate with Ease
 - The site's user-friendly design makes it simple to move between features and complete your export tasks.

9. CONCLUSION

Ex-Zier is a smart and practical digital platform that addresses both the educational and operational challenges of export pricing. By simplifying the complexities of international trade, it makes export pricing more accessible and easier to understand for a wide range of users. Its real-time features and user-friendly interface meet the growing demand for accurate, efficient tools in global commerce. With its comprehensive approach, Ex-Zier is well-positioned to become a valuable resource for businesses, entrepreneurs and learners alike, offering a reliable solution for export pricing and currency conversion in an increasingly connected world.

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Chapter 45

Fabrication of Organic Field-Effect Transistor-Based Biosensor

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ABSTRACT

In this project, triisopropylsilylethynyl-pentacene (TIPS-pentacene) will be utilized as a semiconducting polymer matrix for the preparation of biosensors based on organic field-effect transistor (OFET) structure. A thin layer of TIPS-pentacene can be easily formed on a silicon substrate through solution processable technique. Through polymer blend method which allows synergistic combinations of stacking configurations of multiple polymers energy levels which will enhance overall charge transport. Novel pentacene derivatives will also be proposed using machine learning method and computational study for synthesizing new narrow energy band gap polymer matrix. Analytical techniques, such as ultraviolet-visible (UV-Vis) spectroscopy will be used in the characterization of the materials properties. The proposed biosensor based on integration of biological compound into OFET will facilitate the government.

Key Words: Triisopropylsilylethynyl-pentacene; organic field-effect transistor; semiconducting polymer matrix; biosensor

1. INTRODUCTION

Previous research has demonstrated the potential of organic field-effect transistor (OFET) based biosensors for detecting the various disease by the presence and amount of biological compound. The non-volatile of OFET memory devices also have attracted the eyes of

technologies due to their easily integrate switching structure and non-destructive readout. The OFET can help us in various of way it can be. It has prospective applications in a number of domains that may have an influence on day-to-day living, such as sensing technologies, healthcare, and flexible electronics.

2. LITERATURE REVIEW

In the previous research, they have demonstrated the potential of OFET-based biosensors for detecting the various disease by the presence and amount of biological compound. The OFET devices eventually has limitation to their performance and affect environments due to lack of charge mobility, stability and reproducibility(Ajayan et al., 2023). There are several method and strategies that can optimize the functionality of OFET device. This is one of the ways to increase the functionality of OFET devices called blend strategy which make detection infectious diseases more accurate and faster. The blending techniques can significantly increase the charge carrier transport that able to increase charge mobility.

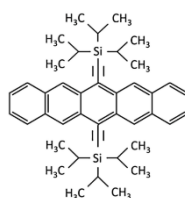


Figure 13: TIPS-pentacene molecular structure

In this project, 6,13-bis(triisopropylsilylethynyl)pentacene (TIPS-pentacene) will use as polymer matrix for the preparation of OFET-based biosensor. The TIPS-pentacene was selected as main polymer matric due to it has high solubility in many organic solvents which make it easier to be utilized in many solutions process methods for the large area and low cost for electronic devices. As shown at Figure 1, it also can be using the same solvent that be dissolved by other semiconductor materials. By mixing TIPS-pentacene, it can allow its electrical parameter such as energy band gap so it can be tuned. It is expected that by reducing the energy band gap, it can help to increase the mobility. Two different conjugated polymers with different band gap and tunable will produced a composite that could be adjusted by changing the blending ratio of the two polymers.

3. METHODOLOGY

3.1. Synthesis of narrow the energy band gap of pentacene derivatives

TIPS-pentacene, a conjugated polymer will be dissolved using two different solvents, chloroform and dimethylformamide (DMF). After mixing TIPS-pentacene with each solvent, they will be constantly stirring for 1 hour using magnetic stirring to obtain evenly solution. As result, there will be two sample for each solvent. The samples will be undergoing UV-Vis test. A new solution of co-polymer materials will be prepared for creating interpenetrating polymer-networks (IPN).

3.2 Fabrication of organic field effect transistor

The ITO glass substrate was purchased from Ossila which is uses for OFET and sensing. It has been designed to enable the fabrication and characterization of transistor and sensing devices without need for vacuum evaporations or probe station. This is for make a system more ideal to reducing materials screening experiments cost while allow devices to be produced and tested with a notably simpler approach.

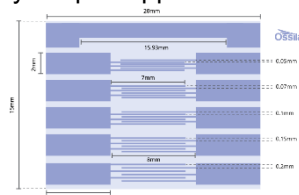


Figure 2: Ossila ITO OFET substrate variable schematic

The transistor can be fabricated by simply depositing an organic semiconductor, gate insulator and gate on the substrates. Synthetic metal such as PEDOT; PSS, deposited from solution for the gate, will make a fully functional OFET with solution processing alone and eliminating vacuum evaporation process. The substrates were designed to work on with wide different material system which allow transistor to be fabricated in the matter of times.

3.3 Optimization of biosensor

To achieve optimized interpenetrating polymer networks (IPN) by using the combination of other polymer materials. The TIPS-pentacene will be added into this co-polymer solution to tune its energy band gap. The same method of phase 2 are used to fabricate the same OFET sensor devices but with a different combination of co-polymer IPN. The process will be continuing by fabrication the same OFET biosensor devices on the ITO coated PET film with pre-patterned source drain channel.

3.4 Collecting data and analyse

The fabricated OFET biosensor will be connected to a microcontroller unit (MCU) and an Analog Devices M1K ADALM1000, which will be used to collect data based on changes in electrical signals when the sensor detects the presence of a target substance. The result will be analysed using Tauc plot method. This method will help us to determine the optical band gap energy. The optical band gap energy of semiconductor is a crucial parameter that will defines the minimum photon energy required to excite an electron from the valence band to the conduction band.

4. RESULTS AND DISCUSSION

The electrical properties of an organic semiconductor are studied to measure the current-voltage characteristics. The charge carrier transport in the polymer material across a gap between the source and drain terminal will be the main electrical characteristic in the OFET.

By using UV-Vis spectroscopy, the results are obtaining which can determine the material's light absorption in solution form



Figure 3: The plotted graph of TIPS-pentacene solvent with chloroform

Figure 4: The plotted graph of TIPS-pentacene solvent with dimethylformamide

As shown at Figure 3, the energy band gap was calculated by software when we enter the data. The Tauc Plot are used to determine the optical bandgap, either disordered or amorphous semiconductors. The optical band gap of TIPS-pentacene ranging from 1.6 eV to 1.87 eV. In this research, the value of optical bandgap was found to be 1.888 eV when dissolve in chloroform. While for the graph absorbance vs wavelength (nm), the curve shows the same curve of the blue colour wavelength which is peak between 600 nm to 700 nm. The value of energy band gap, 1.875 eV was obtained when dissolved in DMF as shown at Figure 4. The result of UV-Vis spectrum also similar to TIPS-pentacene dissolved in Chloroform.

The formula uses to calculate the Tauc plot is:

$$(\alpha h\nu)^{1/n} = A (h\nu - E_g) \quad - \quad (1)$$

where α is absorption coefficient being a function of wavelength $\alpha(\lambda)$, h is Planck constant, E_g is an optical band gap of a semiconductor, ν is frequency, A is proportionality constant, and n is Tauc exponent. Tauc coefficient is typically chosen as one of four values depending on the type of dominating transition in a studied semiconductor and according to the commonly used rules, $n = 1/2$ for direct (allowed) transitions, $n = 3/2$ for direct (forbidden) transitions, $n = 2$ for indirect (allowed) transition, $n = 3$ for indirect (forbidden) transitions (Haryński et al., 2022).

5. CONCLUSION AND RECOMMENDATION

The solution of TIPS-Pentacene dissolved in both DMF and chloroform have been prepared to determine optical energy band gap. This measure will be very helpful for the fabrication of OFET- based biosensor. By comparing the result between two solvent, the DMF have slightly better in bandgap energy which is 1.875 eV while for solvent chloroform which is 1.888 eV. By combining both lower bandgap blended polymer matrix and increase in Gate applied voltage which make detection rate will significantly increase. It can be a potential candidate for biomedical sensor to rapidly detect infection diseases because of have better internal charge carrier.

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Chapter 46

SmartRackX

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ABSTRACT

Warehouse management is critical in the logistics industry, notably for inventory management as well as preventing human error. Standard storage systems, however, commonly lack automation, real-time tracking, and error detection. It will result in inefficiencies and operational delays in the warehouse operation. SmartRackX was designed to address all these challenges. SmartRackX was created to provide warehouses with an intelligent and automated racking system that enhances inventory visibility. SmartRackX utilizes RFID technology, real-time sensors, and digital display screens to track product movement, identify defective positioning, and display information about the products on compact displays attached to each rack. This method enables warehouse personnel to rapidly monitor inventory and decrease the possibility of misplaced or undocumented products. Although racking systems with RFID monitoring have been on the market, our idea for SmartRackX is to integrate RFID with integrated sensors and smart display screens to offer a more interesting and effective solution. We have included item condition detection features like temperature, which make SmartRackX ideal for a broader range of companies that handle sensitive or fragile goods in the warehouse. These additional features of SmartRackX can define the product and make it more competitive than common smart racks, which will provide an extensive solution to modern warehouse difficulties. SmartRackX's innovation contributes to digital transformation in supply chain management by enabling smarter, efficient warehouse operations and always being one step ahead.

Key Words: Warehouse management, RFID technology, SmartRackX, inventory visibility, integrate

1 INTRODUCTION

In today's fast-paced warehouse and logistics industry, accuracy, efficiency, and real-time inventory control are critical. Traditional warehouse systems frequently rely on manual processes and centralized data, which results in human error, duplicate data, and increased

delays. SmartRackX was created to address these issues by combining RFID technology, built-in sensors, and local smart display panels. Each rack runs autonomously, eliminating the need for a central computer and minimizing human involvement in scanning and data entry. SmartRackX displays real-time inventory levels directly on the rack, making it ideal for high-volume environments. It enables the transition from reactive to proactive inventory management through real-time, automated data.

1.1 Objectives of The Innovation

The primary goals of SmartRackX are to automate the identification and removal of products while decreasing dependency on centralized systems. Manual scanning was previously time-consuming and prone to error, but with built-in RFID readers, SmartRackX can identify and track item movement in real time without human intervention, enhancing accuracy and efficiency (Guenes, 2024). Furthermore, by processing data locally and only delivering validated transactions to the central system, SmartRackX decreases system overload, network traffic, and provides steady operations even if the main system fails (Murugan, 2024).

1.2 Problem Statement

Many modern warehouses confront significant issues due to their reliance on centralized systems. If the central system fails, operations can come to a total standstill, producing significant interruptions, particularly in fast-paced supply chains. This setup also lacks redundancy, making it unreliable and inefficient. Another concern is system overload and data duplication when several objects are scanned or processed at the same time, the system slows down or generates duplicate entries, reducing inventory accuracy. Furthermore, the lack of real-time visibility encourages workers to trek across huge warehouse locations only to retrieve data, wasting time and raising the risk of errors and delays.

2 DESCRIPTION OF THE INNOVATION

2.1 Details of the Innovation Product or Solution

SmartRackX includes RFID for automatic item tracking, sensors for weight, impact, and environmental monitoring, and real-time inventory display screens. It also employs edge computing, which allows each rack to handle data independently, minimizing network traffic and maintaining ongoing operation even when the central system fails, so enhancing overall warehouse efficiency.

2.2 Key Features and Uniqueness

SmartRackX includes crucial features such as RFID for automatic item tracking, built-in sensors for weight, impact, and environmental monitoring, and real-time display screens for inventory updates. It also employs edge computing, which allows each rack to handle data independently, decreasing network traffic and ensuring uninterrupted operation even after system failures.

2.3 Novelty

SmartRackX is an innovative multi-technology integration that combines RFID with integrated sensors for weight, impact, and environmental monitoring within a single rack system, which is still unusual in today's warehouses (Kalany, 2021). These sensors detect product presence, damage, and environmental variables, allowing for predictive monitoring to reduce losses and maintain product quality. Furthermore, edge computing enables each rack to process data independently, preventing server overload, network congestion, and central system failures. This decentralisation ensures that racks remain operational even during system interruptions. SmartRackX also has real-time local displays that reveal item details and send alarms for damage or unauthorised movement, which improves security and efficiency.

3 PRODUCT USAGE

3.1 Instructions on How to Use the Product

To use SmartRackX, each item or pallet must be tagged with a valid RFID chip for automatic tracking. When products are placed on a rack, the embedded RFID readers recognise them while the system monitors temperature and humidity. As things are added or withdrawn, the smart display automatically changes, displaying information such as the date, time, and status. If unlawful removal, missing RFID tags, or damage is discovered, the system delivers real-time notifications to workers, allowing for prompt replies. This configuration avoids the need for central systems or human checks by giving up-to-date inventory and condition data directly from each rack.

3.2 Target Users and Application Areas

Warehousing operators and logistics specialists, along with inventory staff in logistics distribution centres or e-commerce warehouses and cold chain operators of food and pharmaceuticals, electronic equipment, and manufacturing facilities, make up the target audience for SmartRackX. The survey results validate the growing market demand for SmartRackX because end users currently face difficulties with manual inventory tracking and both accuracy and operational efficiency issues.

4 SURVEY AND FEEDBACK

4.1 Survey Design and Methodology

A total of 50 students participated in the survey to share their views about warehouse management systems with linked technologies. The questionnaire used structured survey.

4.2 Findings From User Feedback

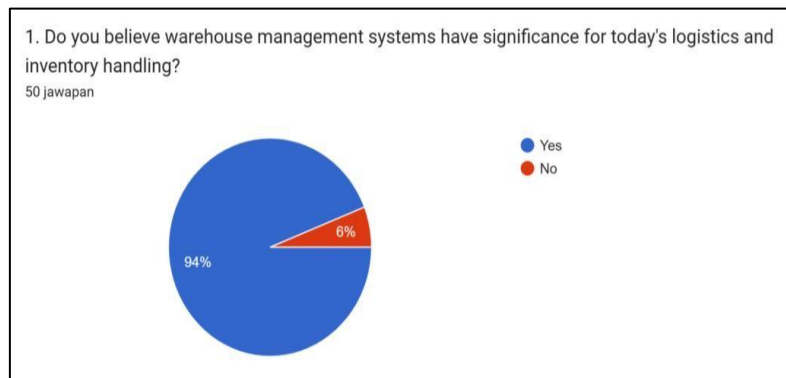


Diagram 1

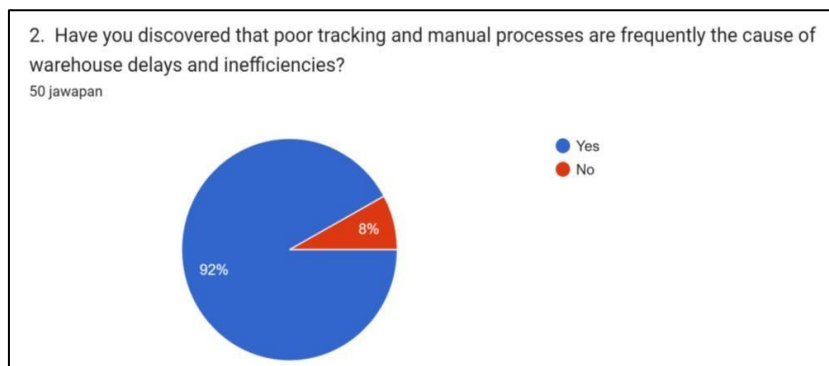


Diagram 2

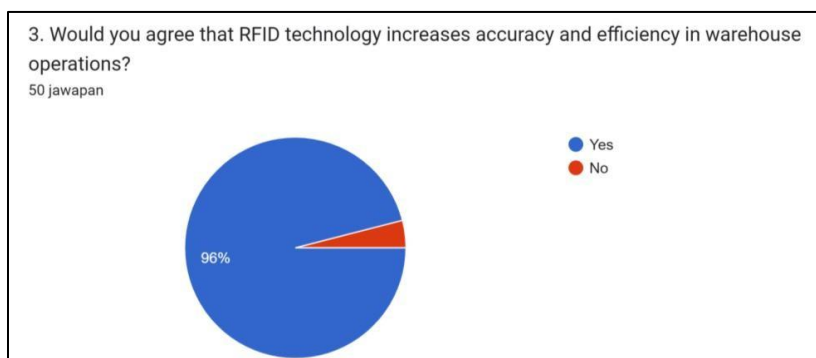


Diagram 3

5 COMMERCIALIZATION AND IMPACT

5.1 Potential For Commercialization

SmartRackX is a game changer in businesses such as transportation, e-commerce, cold chain management, and manufacturing, where efficiency and accuracy are critical. It

addresses the growing demand for faster, more error-free procedures by providing a modular solution that combines RFID, sensors, and edge computing. This combination enables warehouses to automate inventory tracking and monitor product conditions in real-time. What distinguishes SmartRackX is its ability to simplify data administration and accelerate decision-making, hence eliminating waste and increasing productivity. Furthermore, with its emphasis on sustainability, it's an excellent alternative for businesses trying to lessen their environmental effect in today's eco-conscious market.

5.2 Benefit To Community or End Users

SmartRackX increases both business operations and societal benefits by increasing supply chain efficiency and sustainability. Inventory tracking is automated using RFID and sensors, which reduces errors and ensures real-time, accurate data. This helps to avoid out-of-stock situations and reduces expenditures. It also improves product safety, particularly for foods and pharmaceuticals, by reducing deterioration and contamination. Additionally, SmartRackX decreases waste and energy consumption, boosting environmentally responsible logistical operations.

6 CONCLUSION

SmartRackX transforms warehouse operations with RFID tracking, sensor monitoring, and real-time displays, reducing manual errors and increasing data reliability. Decentralizing data processing speeds up operations and improves system resilience. This technology transforms warehouse procedures, increasing supply chain efficiency and bringing long-term advantages to organizations and communities.

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Chapter 47

Dielectric Characterization of Flexible Pineapple Leaf Fiber (PALF) Reinforced Polydimethylsiloxane (PDMS) Composite as a Potential Antenna Substrate for Wearable Antenna Application

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ABSTRACT

The rapid advancement of wearable technology has increased the demand for flexible, lightweight, and high-performance antenna substrates. This study investigates the dielectric properties of Pineapple Leaf Fiber (PALF) reinforced Polydimethylsiloxane (PDMS) composites as a potential substrate for wearable antennas. The fabrication method used was Manual Polymer Mixing Method. The composites, with fiber loadings from 10wt.% to 90wt.%, underwent alkaline treatment using Sodium Hydroxide (NaOH) to enhance fiber-matrix compatibility. Dielectric properties were analyzed using a Vector Network Analyzer (VNA) to measure dielectric constant, loss tangent, and permittivity. Results indicate that increasing fiber loading improves the dielectric constant, while alkaline treatment reduces the loss tangent, enhancing performance. The treated composites demonstrated superior mechanical stability and flexibility, crucial for wearable applications. Additionally, CST Studio-designed antenna prototypes showed improved radiation patterns, return loss, and efficiency, confirming PALF-PDMS as a suitable dielectric substrate. These findings highlight the potential of sustainable natural fibers for advanced, eco-friendly electronic applications.

Key Words: Biofibre-reinforced composites, Pineapple Leaf Fibre (PALF), Polydimethylsiloxane (PDMS), Dielectric characterization, Fibre Loading, Alkaline treatment

1. INTRODUCTION

Natural fibres have gained attention as reinforcement materials due to their excellent mechanical properties, biodegradability, and eco-friendly nature. In contrast, conventional

materials such as FR4, Rogers RT/duroid 5880, and polyimide, though widely used, present several drawbacks including rigidity, environmental concerns, high cost, and lack of biodegradability (ENGHETA, 2005; HUANG ET AL., 2013). One significant limitation is their fixed dielectric constant, which cannot be easily modified, a challenge that natural fibres can potentially overcome. Biofibre-reinforced polymer composites offer a promising alternative thanks to their mechanical strength, flexibility, and sustainable profile. Moreover, the dielectric properties of biofibres, particularly their typically low dielectric constant and loss, can be tuned by adjusting the material's weight percentage. Although previous studies have highlighted the promise of bio-based materials in electronic applications, comprehensive research on their dielectric characterization as substrate materials remains limited (LEE, 2017; MISHRA & RAJPUT, 2020).

2. LITERATURE REVIEW

A study (Zulkifli et al., 2017) demonstrated that altering filler content results in varied tangent loss and dielectric constant values. Moreover, different agricultural waste materials—such as rice straw, rice husk, sugarcane bagasse, and banana leaves—when combined with Epoxy 331, exhibit distinct dielectric behaviours. A higher dielectric constant is desirable for substrate applications, while a higher loss tangent is beneficial for microwave absorber use. Further research (Jayamani et al., 2014; Kulandaisamy & Govindasamy, 2020) revealed that increasing the fibre weight percentage in hybrid composites tends to raise the dielectric constant, dissipation factor, and loss factor. Interestingly, the type of polymer matrix shows minimal influence on the dielectric performance of these composites. Additionally, composites made with fibres that underwent alkaline treatment generally exhibited a lower dielectric constant, attributed to enhanced fibre hydrophobicity.

3. MATERIALS AND METHODS

3.1. Materials

Pineapple Leaf Fibre (PALF), a natural fibre, was selected for further study due to its distinctive properties and strong potential for the targeted application. Polydimethylsiloxane (PDMS) was chosen as the polymer matrix because of its recognized flexibility, optical clarity, and biocompatibility (Gbotemi et al., 2018). Additionally, alkaline treatment using Sodium Hydroxide (NaOH) has proven to be an effective method for enhancing fibre–matrix compatibility, improving the fibre's structural qualities, and contributing to the development of high-performance composite materials (Bekele et al., 2023; Kaima et al., 2023).



Figure 1: PALF (a) Pure (b) Treated

3.2. Fibre Treatment

The pineapple leaf fibre undergoes an alkaline treatment to improve the compatibility of the fibres with the polymer matrix. The surface treatments using Sodium Hydroxide (NaOH) were then applied to the fibres. Pineapple leaf fibres were soaked in 1.5M concentration of NaOH solution for 3 hours at room temperature. Then the fibres were washed several times with distilled water until neutral pH was achieved and finally the oven dried at 80 °C for 48 hours as depicted in Figure 1(b).

3.3. Composite Preparation (Manual Polymer Mixing Method)

Raw pineapple leaf fibres (PALF) were processed by grinding into fine particles or cutting into 10 mm lengths for treated samples. Polydimethylsiloxane (PDMS) was mixed with its curing agent in a 10:1 ratio, after which the treated fibres were gradually added to ensure uniform dispersion. Both PALF and PDMS were accurately measured and blended in a specific ratio. The mixture was stirred continuously for five to ten minutes as PDMS was added gradually, promoting even distribution. Finally, the composite mixture was poured into a mold and compressed with weights to ensure consistent thickness.

3.4. Composite Formulation

Different fibre loadings were formulated by varying the weight percentage of PALF within the composite, specifically at 10wt%, 20wt%, 30wt%, 40wt%, 50wt%, 60wt%, 70wt%, 80wt%, and 90wt%. These loading levels were applied to both untreated (pure) and alkaline-treated fibres.

3.5. Dielectric Measurement

The dielectric constant, also known as relative permittivity (ϵ_r), plays a vital role in influencing the impedance, bandwidth, and radiation efficiency of antennas by controlling the propagation speed of electromagnetic waves through a material. For wearable antenna designs to perform effectively, precise measurement of the dielectric constant is essential (John & Thomas, 2008; Mishra & Rajput, 2020).

Table 3 Pure Fibre Dielectric Properties

Weight Percentage	10	20	30	40	50	60	70	80	90
Parameter									
Dielectric Constant, ϵ_r	1.65	1.67	1.89	1.92	1.94	1.95	2.18	2.6	2.63
Tangent Loss, $\tan \delta$	0.04	0.18	0.19	0.2	0.2	0.23	0.25	0.38	0.41

Table 2 Treated Fibre Dielectric Properties

Weight Percentage	10	20	30	40	50	60	70	80	90
Parameter									
Dielectric Constant, ϵ_r	1.58	1.59	1.71	1.78	1.85	2.14	2.59	2.7	2.98
Tangent Loss, $\tan \delta$	0.14	0.16	0.18	0.25	0.25	0.31	0.34	0.43	0.44

3.6. Antenna Fabrication

After curing, a copper sheet was applied on the top surface of each substrate to form the radiating patch and feedline, based on the design shown in Figure 2(a). An SMA connector was soldered at the edge of the feedline for RF measurements. The backside of each substrate was fully covered with copper tape to act as the ground plane, resulting in a complete microstrip antenna structure, as illustrated in Figure 2(b). A total of 18 microstrip patch antennas were fabricated using PALF (pineapple leaf fiber)-reinforced PDMS (polydimethylsiloxane) composites as the substrate material shown in Table 3.

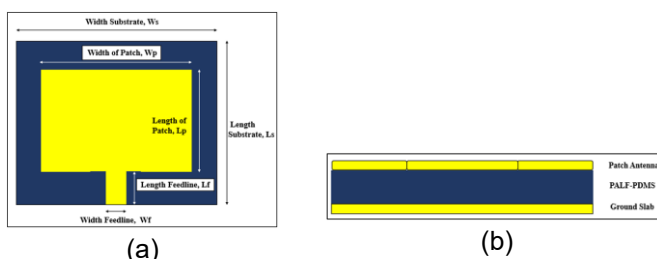


Figure 2: Microstrip Patch (a) Antenna Dimension (b) Cross Sectional

Table 3 Fabrication of Antenna

Weight Percentage	10wt.%	20wt.%	30wt.%	40wt.%	50wt.%	60wt.%	70wt.%	80wt.%	90wt.%
Pure									
Treated									

4. RESULTS AND DISCUSSION

This study confirms the potential of Pineapple Leaf Fibre (PALF) reinforced Polydimethylsiloxane (PDMS) composites as effective substrate materials for dielectric applications. The dielectric constant of both pure and treated composites increases with rising fibre loading, with a notable enhancement observed in treated PALF beyond 60 wt.% as shown in Table 1 and Table 2. This improvement is attributed to the stronger interfacial bonding between fibre and matrix following alkaline (NaOH) treatment.

4.1 Effect of Fibre Loading:

The dielectric constant increases proportionally with fibre loading. While pure PALF composites exhibit higher dielectric constants at lower fibre percentages, treated PALF surpasses the pure variant above 60 wt.%. This is due to enhanced interfacial polarization and the higher cellulose content in treated fibres.

4.2 Effect of Alkali Treatment:

Alkaline treatment removes non-cellulosic components, improving fibre-matrix compatibility and reducing hydrophobicity. This results in better fibre orientation and bonding, especially at higher fibre loadings, which contributes to the increase in dielectric constant beyond 70 wt.%.

5. CONCLUSION AND RECOMMENDATIONS

This study demonstrated that PALF-reinforced PDMS composites possess favorable dielectric properties, mechanical flexibility, and sustainability, making them suitable as wearable antenna substrates. The material showed a stable dielectric constant and low loss tangent, along with enhanced flexibility and structural integrity, supporting efficient and eco-friendly communication. For future work, research should long-term stability under environmental and mechanical stress and investigate large-scale fabrication methods to enable practical use in next-generation wearable technologies.

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Chapter 48

IProtectV: Enhancing Workplace Safety Through Smart Technology

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ABSTRACT

Product innovation is one of the key methods to enhance capabilities and ensure that work processes can be carried out efficiently and effectively. The aim of innovation is to reduce waste, whether in terms of costs, time, or operational procedures, so that tasks can be performed optimally. Currently, worker safety has become a legal priority and a central focus in safeguarding employee welfare. Therefore, the development of the iProtectV smart safety vest is proposed for workers in all industrial sectors to address growing safety concerns. This innovative product is equipped with high-tech components such as geofencing and RFID to ensure the effectiveness in reducing accidents rates, especially among lone workers. In addition to the use of IoT, other features have been enhanced, including health sensors and ECG monitoring to detect workers health conditions in real time. The use of polyester as the main component of the design as available in the market then mesh in some parts increases comfort for users. With its user-friendly design, this product has strong potential for widespread commercialization across various industries.

Key Words: Warehouses, real-time monitoring, fatigue detection, safety, high tech

1. BACKGROUND

Workers in logistics, warehousing, and construction face daily risks, including heavy machinery and working alone in hazardous areas. Despite safety gear, accidents remain common, indicating current equipment is insufficient. In Malaysia and other countries, accidents often result from worker inattention and lack of monitoring, especially in isolated settings. The iProtectV vest addresses this by tracking worker locations, sending alerts, and ensuring real-time safety. With features like GPS, sensors, and warning lights, it enhances

safety and helps companies respond quickly to emergencies, offering a smarter, more effective safety solution.

2. PROBLEM STATEMENT

The logistics and warehousing industry face high accident rates, contributing significantly to global workplace fatalities, with Malaysia recording 99 incidents per 10,000 workers. Accidents often stem from worker negligence and lack of monitoring in large areas, especially affecting lone workers who struggle to communicate during emergencies. As recommended by Europe OSH, effective protective equipment is essential, since certain risks are unavoidable. However, a Kimberly-Clark survey shows that simply wearing safety gear is not enough—more advanced and effective solutions are needed to ensure worker protection.

3. OBJECTIVES

3.1 Enhanced Worker Safety

iProtectV reduces risks such as collisions, falls and equipment related accidents, especially for lone workers through real-time alerts and built in communications tools

3.2 Real-Time Monitoring & Geofencing

Tracks worker location and movement, prevents entry into hazardous zones and provides instant hazard alerts using smart geofencing technology

3.3 Boosts Safety Awareness & Compliance

Encourages safety-conscious behavior, improves discipline and helps companies meet DOSH safety standards while supporting ESG initiatives

4. NOVELTY

4.1 Smart Safety for Construction Workers

iProtectV is an innovative upgrade from standards safety vest, offering real-time hazard detection, location tracking and task support ensure greater safety on dynamic construction sites

4.2 IoT Integration for Health & Movement Monitoring

With IoT technology, iProtectV allows supervisors to monitor worker movements, fatigue levels and vital signs, reducing risks of overwork, accidents and unmonitored activity in dangerous zones

4.3 Instant Alerts & Mental Health Assistance

The vest includes automatic communication tools that detect distress such as anxiety or medical emergencies and send alerts to the admin and nearby workers for rapid response and support.

5. KEY FEATURES AND UNIQUENESS

The iProtectV vest combines comfort, durability, and technology. Its lightweight, breathable mesh polyester ensures comfort and prevents overheating, while Cordura fabric provides abrasion resistance, making it tear, puncture, and rub resistant. Next, iProtectV vest has a breathable mesh lining for comfort and airflow, especially in hot areas. Nylon webbing straps

with Velcro or buckles ensure a secure, adjustable fit, keeping the vest in place during activities like lifting or bending. The vest's LED warning lights are housed in lightweight, impact-resistant polycarbonate. Its flexible PCBs, connected with conductive thread, enable seamless integration of motion sensors, temperature monitors, GPS trackers, and vibration alerts.

6. PRODUCT USAGE

The iProtectV smart safety vest is designed for workers in high-risk environments like warehouses, construction, factories, and logistics. It's easy to use—simply wear it like a regular vest and adjust the straps for a comfortable fit. The vest automatically activates upon wearing, turning on its smart features without needing to press a power button. It monitors safety through sensors, with geofencing to alert workers when entering dangerous areas by vibrating or flashing lights. Fall detection is also automatic, triggering alerts if a worker falls. In emergencies, workers can press a button to send alerts to supervisors. The vest automatically turns off after the shift ends and should be charged before the next use to ensure full functionality.

7. COMMERCIALIZATION POTENTIAL

iProtectV has great potential because nowadays the global workplace safety market is growing rapidly, driven by increased awareness of worker health and safety, particularly in physically demanding industries such as construction, logistics, and warehousing. According to Markets (2022), the market is expected to expand from USD 14.2 billion in 2022 to USD 26.7 billion by 2027, with a Compound Annual Growth Rate (CAGR) of 13.5%, fuelled by contributions from smart wearable technologies.

Common warehouse accidents, such as slips, trips, falls, manual handling injuries, crash injuries, machinery accidents, and falling objects, frequently occur in the workplace (Solicitors, n.d.). For example, a man tragically fell to his death at Arlington warehouse (Coombs, 2025). The iProtectV vest can monitor worker fatigue, alert them to nearby hazards, and track conditions like body temperature, potentially reducing such incidents. This functionality is particularly valuable in warehouses, where workers face risks from prolonged strain and hazardous conditions. The commercial potential of this vest is significant, as it helps minimize warehouse accidents.

8. BENEFITS TO COMMUNITY

8.1 Improved Workplace Safety

iProtectV helps prevent common accidents such as falls, fatigue related incidents. Through features like motion sensors, fatigue tracking and real time hazard alerts.

8.2 Better Worker Well-Being

By reducing injuries, iProtectV promoted a healthier workforce and supported a better quality of life both on and off the job

8.3 Increased Productivity & Economic Impact

A safer work environment boosts employee morale, enhances performance, lowers turnover and reduces recruitment and training costs and leads to long-term economic benefits for the community.

9. FEEDBACK FROM COMMUNITY

Based on the survey results, the community shows interest in smart safety devices. Opinions shared through these surveys highlight the importance of increasing awareness and provide clear information about these devices to maximize the adoption and the impact on them.

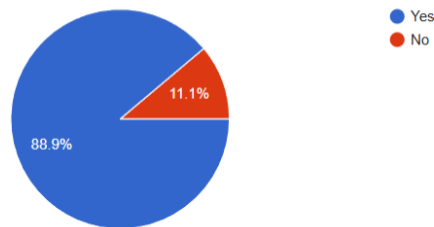


Figure 1: Results of survey distributed among UiTM students.

The chart shows that 88.5% of respondents are aware of wearable safety devices, highlighting growing recognition of smart technology in workplace safety. Devices like the iProtectV vest offer features such as geofencing and real-time monitoring to reduce risks. However, 11.1% remain unaware, indicating the need for improved outreach and education for wider adoption.

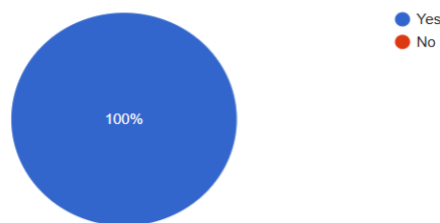


Figure 2: Results of survey distributed among UiTM students.

The survey results show 100% support for a system that alerts nearby people in case of a fall or danger, indicating high demand for immediate alert features. This feedback suggests that integrating automatic alerts into safety devices could improve emergency response and workplace safety by enabling quicker help.

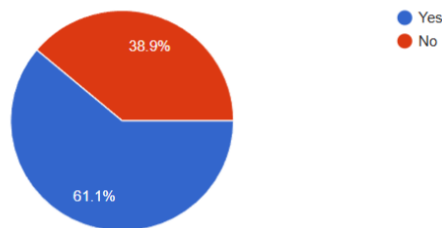


Figure 3: Results of survey distributed among UiTM students

The charts provide two overviews of how familiar people are with IoT (Internet of Things) and smart sensors. In the charts, 61.1% of respondents said they are familiar with these concepts, while 38.9% indicated that they are not, which suggests there is room to boost awareness. 61.1% of respondents showed familiarity, meaning they know about IoT and smart sensors. These differences might reflect diverse groups or targeted audiences, but they clearly show that while many understand these technologies, others could benefit from more accessible information

10. CONCLUSION

In conclusion, adopting advanced safety technology like iProtectV is crucial to addressing high workplace accident rates in the logistics and warehousing sectors. With logistics being a leading cause of work-related fatalities globally, iProtectV integrates smart wearables, geofencing, real-time monitoring, and fatigue detection to enhance worker safety, communication, and emergency response. It also improves compliance with safety regulations like those set by DOSH and offers significant economic potential as the market for smart safety solutions grows. By reducing injuries, iProtectV boosts worker morale, productivity, and overall societal well-being. This innovative solution provides a safer, smarter, and more sustainable approach to high-risk industries.

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Chapter 49

Detariffed Premium Estimation for Automobile Insurance: Modelling Frequency and Severity Using Poisson, Lognormal, Pareto and Generalized Linear Model

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ABSTRACT

The transition from a tariff-based to a de-tariffed automobile insurance market in Malaysia has significantly reshaped premium estimation thus requiring for more accurate risk assessment among insurance companies. This project provides significant milestones by investigating the effects of de-tariffication by modelling claim frequency and severity using real-world insurance data. Advanced statistical models have been applied for robust premium pricing in which Poisson and Zero-Modified Poisson (ZMP) models were employed to model claim frequency. Moreover, Lognormal and Pareto distributions models were adopted to model the respective claim severity. The Lognormal distribution best captured small to moderate claims, whereas the Pareto model better represented extreme losses. Model evaluations favored the Lognormal distribution due to its superior goodness-of-fit metrics. We propose Generalized Linear Models (GLMs) to estimate pure premiums. The tariff model included factors like Cylinder Capacity and vehicle value, while the de-tariff model incorporated additional risk variables such as driver age, experience, vehicle age and power, second driver availability, area classification, and vehicle value. Findings confirm that risk-based pricing allows for fairer, more personalized premiums but also introduces new challenges like price competition and adverse selection. This research offers important insights for insurers, actuaries, and regulators striving for pricing sustainability.

Key Words: De-tariffication, Premium estimation, Claim frequency, Claim severity, Generalized Linear Model (GLM).

1. INTRODUCTION

The automobile insurance industry plays a vital role in managing risks, particularly in Malaysia, where road accidents are on the rise. In 2017, the industry experienced a significant transformation with the implementation of a de-tariffed model, which introduced risk-based pricing. This shift increased the need for more accurate premium estimation methods. Accurate claim prediction has become essential for ensuring financial stability and fairness in pricing. This study sets out to address these challenges with four key objectives. Firstly, this study aims to model the frequency of automobile insurance claims using both the Poisson and Zero-modified Poisson models. Secondly, it seeks to model claim severity using Lognormal and Pareto distributions. Thirdly, this study focuses on modelling the pure premium of automobile insurance in the context of de-tariffication, employing a Generalized Linear Model (GLM). The findings are expected to benefit a range of stakeholders, including regulators, insurers, and academic researchers.

2. LITERATURE REVIEW

This study examines the impact of de-tariffication on Malaysia's motor insurance, focusing on claim frequency, severity, and premium modelling. It evaluates statistical models such as Poisson, Zero-Modified Poisson, Lognormal, Pareto, and Generalized Linear Models (GLM) to enhance risk-based pricing and insurer sustainability. Malaysia's transition to a risk-based pricing model in 2017 replaced fixed tariffs, promoting fairer premiums and market competition. However, challenges such as price instability and imperfect competition persist. Effective risk assessment methods are crucial to ensuring balanced premium structures and market stability. Several factors influence claim frequency and severity. The zero-claim phenomenon arises when policyholders avoid small claims to retain No-Claim Discounts (NCD), leading to excess zeros in datasets. The Zero-Inflated Poisson model effectively accounts for this issue. Claim frequency and severity are also interdependent, requiring two-part models for accurate risk assessment. Additionally, outliers and skewed data impact risk modelling, necessitating proper statistical methods to ensure fair premium calculations. Risk assessment and pricing rely on statistical models that incorporate factors such as demographics and vehicle characteristics. Advanced modelling approaches, including Conditional Probability Decomposition and Copula Models, improve claim predictions. Since de-tariffication, insurers have adjusted their rating factors, with studies identifying key determinants like driver age, vehicle type, mileage, and NCD levels. This research extends previous works by applying Poisson and Zero-Modified Poisson (ZMP) models to analyze claim frequency and Lognormal and Pareto distributions are used, Lognormal for moderate claims and Pareto for extreme losses, ensuring accurate premium estimation. In addition, premium calculation is performed using Generalized Linear Models (GLM), which account for the relationship between claim frequency and severity, improving pricing accuracy. This study provides a statistical foundation for risk-based pricing in Malaysia's de-tariffed motor insurance market, offering insights for regulators, insurers, and policymakers.

3. METHODOLOGY

This study uses a 2018 Spanish motor insurance dataset comprising 28,037 policy records (risk type 3 – passenger cars) with 19 attributes including policyholder details, vehicle information, and claims history as in the Table 1.

Table 1 List of attributes and explanations from data

Attribute	Explanation	Variable
Policy Year	Year of the policy.	
Year of Birth	Policyholder's years of birth.	
Age	The age of policyholder in the year of 2018.	x_1
Driving Experience	How many years the policyholders had their driver license since 2018.	x_2
Annual Claim Cost	Total cost of claims incurred for the insurance policy during the current year.	
Number of Claims	Total number of claims incurred for the insurance policy during the current year.	
Area Type	Dichotomous variable indicates the area. 0 for rural and 1 for urban (more than 30,000 inhabitants) in terms of traffic conditions.	x_3
Second Driver	1 if there are multiple regular drivers declared, or 0 if only one driver is declared.	x_4
Vehicle Registration Year	Year of registration of the vehicle (YYYY).	
Vehicle Age	The age of the car in year 2018 (in years)	x_5
Power	Vehicle power measured in horsepower.	x_6
Cylinder Capacity (CC)	Cylinder capacity of the vehicle.	x_7
Vehicle Market Value	Market value of the vehicle on 31/12/2019.	x_8

Claim frequency is modelled using Poisson distribution, appropriate for count data. To handle excess zeros, a Zero-Modified Poisson (ZMP) model is also applied. Parameters were estimated via Maximum Likelihood Estimation (MLE). Claim severity is modelled using Lognormal and Pareto distributions. Lognormal captures right-skewed, multiplicative losses, while Pareto handles heavy tails and extreme claims. The Kolmogorov-Smirnov (K-S) test is used to compare empirical and theoretical cumulative distribution functions, verifying whether the chosen distributions align with the observed data. The AIC and BIC are employed to measure the fitness of the models. Pure premium is estimated by multiplying claim frequency and severity, as expressed by $PP = E(N) \times E(X)$. In the tariff-based approach, premium calculation is primarily influenced by vehicle characteristics such as cylinder capacity and the insured value of the vehicle. In contrast, using Generalised Liner Model, the de-tariffed approach adopts a risk-based framework, incorporating a broader set of factors.

4. RESULTS AND DISCUSSION

Evaluation of models resulted in the Zero-Modified Poisson (ZMP) model outperforming the standard Poisson model for claim frequency with lower AIC and BIC values compared to Poisson. This result highlights ZMP's effectiveness in handling excess zeros in the data, making it the more suitable model for insurance claim frequency analysis. The comparison of

severity models shows that while both capture the heavy-tailed nature of the data, the Lognormal model shows a better fit with lower AIC and BIC, and a smaller K-S statistic values than Pareto. This suggests the Lognormal distribution is more accurate than Pareto particularly for moderate-to-large claims in the datasets. A Poisson Generalized Linear Model (GLM) was applied to estimate claim frequency under both tariff and de-tariff frameworks. In the tariff model, cylinder capacity and vehicle value were used as predictors, with results indicating both variables significantly influenced claim frequency. For the de-tariff model, additional factors such as driver age, experience, car age, second driver availability, and area were included. All were statistically significant except car power. Fitted equations from both models were derived as follows.

Tariff model frequency fitted equation:

$$E(N) = \exp(-2.608881 + 0.0003962x_7 + 0.0000002x_8)$$

De-Tariff model frequency fitted equation:

$$E(N) = \exp(-2.673473 + 0.0060594x_1 - 0.0207724x_2 + 0.1296949x_3 + 0.4234535x_4 + 0.0183851x_5 + 0.0003042x_7 + 0.0000086x_8)$$

A Lognormal Generalized Linear Model (GLM) was used to estimate claim severity, excluding zero claims for consistency. In the tariff model, cylinder capacity (CC) and vehicle value were significant predictors, aligning with traditional premium rules. The de-tariff model included broader variables, but only car age, second driver, and vehicle value were statistically significant. Fitted equations were derived as below.

Tariff model severity fitted equation:

$$E(X) = \exp(5.6994233 - 0.0002686x_7 + 0.0000183x_8)$$

De-Tariff model severity fitted equation:

$$E(X) = \exp(5.955632 - 0.1970641x_4 - 0.0220186x_5 + 0.0000102x_8)$$

Pure premiums were calculated by combining fitted frequency and severity models using GLM. Under the tariff model, premiums were based on cylinder capacity and vehicle value. In the de-tariff model, broader risk factors were included, with the second driver and area having the largest impact, while driving experience reduced premiums. These results highlight how risk-based pricing under de-tariffication enables more accurate and equitable premium estimation. The results illustrate the shift from fixed-rate to risk-based pricing, offering more accurate premium estimation aligned with individual risk profiles.

Table 2 Premium estimated using Tariff model

Value of vehicle (€) \ CC	0 – 1000	1001 – 1500	1501 – 2000	> 2000
270 – 10000	30.06	30.06 - 32.04	32.04 - 34.15	>38.8
10001 – 20000	30.06 - 36.16	30.06 - 38.55	32.04 - 41.09	>34.15
20001 – 100000	36.16 - 158.77	36.17 - 169.23	38.55 - 180.39	> 41.09

Table 3 Premium estimated using De-Tariff model

Value of vehicle (€) \ CC	0 – 1000	1001 – 1500	1501 – 2000	> 2000
270 – 10000	35.34	35.35 - 41.15	41.16 - 47.91	> 64.94
10001 – 20000	35.34 - 42.66	35.35 - 49.67	41.16 - 57.82	> 47.91
20001 – 100000	42.66 - 192.20	42.67 - 223.77	49.68 - 260.53	> 57.83

5. CONCLUSION AND RECOMMENDATION

This study proposed insurance premium modelling in a de-tariffed market, with a focus on comparing traditional tariff-based pricing to risk-based pricing. The Zero-Modified Poisson (ZMP) model was found to be effective in capturing claim frequency, highlighting that younger, inexperienced drivers and older vehicles tend to generate higher claim counts. For claim severity, the Lognormal distribution provided the best fit, effectively reflecting the variation in claim sizes across different driver age groups and vehicle conditions. The estimated pure premiums from the Generalized Linear Model (GLM) model demonstrated that the de-tariffed model produced more accurate and individualized premium estimates. Although risk-based pricing offers a more equitable and precise premium structure, it is crucial to maintain transparency and ensure consumer protection in this evolving market landscape. Future research should consider additional risk factors such as driving behaviour, accident history and road conditions. Incorporating telematics data could further enhance risk assessment and improve the accuracy of premium predictions in a risk-based pricing environment.

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Chapter 50

PilotHub

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ABSTRACT

Efficient pilotage is crucial for safe, timely, and cost-effective port operations, but traditional systems often struggle with delays, high costs, and poor coordination. As part of our IBM554 International Trade course at Universiti Teknologi MARA, we developed *PilotHub*—an innovative mobile app designed to modernize pilotage operations. Pilots face challenges like delayed ship movements, disrupted schedules, and excessive paperwork. PilotHub solves these problems using AI for smart pilot assignment, AR for safer navigation, and digital tools to replace paperwork. The app is mobile-friendly, letting pilots and dispatchers coordinate in real-time. Pilots can log in to see their dashboard with job details, weather, and tide info. They receive assignments based on license type and ship requirements, reducing wait times. AR helps guide ships safely in port, and digital logs make reporting fast and easy. PilotHub is designed for port authorities, pilot services, and shipping companies, offering easy integration and global scalability. We also surveyed 30 maritime professionals to gather feedback and improve the app. Overall, PilotHub improves safety, reduces delays, and streamlines operations, setting a new standard for smart port management.

Key Words: International Trade, Pilotage Services, Port Operation

1. INTRODUCTION

1.1 Objectives

The primary objective of the creation of PilotHub is to develop a mobile and web-based platform that enables real-time monitoring and management of port pilot operations. This objective is taken into consideration after evaluating the self-deployment concerns by pilots at the port, which lead to issues like delayed ship movements, increased cost, disrupted supply chain, inefficient scheduling, and lack of transparency. To achieve this, PilotHub is designed with the following specific objectives; provide instant embarkation/disembarkation

status updates, optimize pilot scheduling through digital planning tools, enable communication between ships, port authorities, and pilots in one platform, record and store historical data for performance analytics, and minimize ship idle time and improve turnaround efficiency.

1.2 Problem Statement

1.2.1 Delayed Ship Movements

Self-deployment by the pilot might create delays in ship movement. This is because the pilot must independently comprehend the data displaying the ship's movement. If the data collected is erroneous, the ship's trip will be hampered since it will have to wait for a new pilot to guide it to its intended location.

1.2.2 Increased Cost

More expenses at a hub owing to self-deployment issues can be caused by a variety of factors, including more infrastructure requirements, complexity, and potentially longer deployment times. These concerns can result in increased expenses in a variety of areas, including software licensing, hardware upgrades, and manual intervention (Kelkar et al., 2025).

1.2.3 Disrupted Supply Chain

When vessels are unable to dock and unload due to a lack of pilots, the port becomes congested, with vessels awaiting entry or exit. This can cause delays in the movement of products, potentially leading to market shortages (Sild, 2024).

1.2.4 Inefficiency Scheduling

A pilot shortage causes schedule problems. Vessels cannot be piloted until a pilot is available, causing delays and even bottlenecks. As a result, vessels may have to wait in port approaches or designated zones until a pilot is available, increasing wait times and expenditures (Hematian et al., 2025).

1.2.5 Lack of Transparency

The lack of openness makes it difficult to monitor pilot numbers, retirements, and training progress. This causes poor planning and delays in hiring or training new pilots. It also has an impact on recruiting, retaining employees, and running daily operations. As a result, pilot shortages intensify, and port efficiency declines.

2. DESCRIPTION OF THE INNOVATION

2.1 Pilot Booking

Pilots can view all incoming vessel assignments with full details including ship ID, license type, estimated time of arrival (ETA), and departure. AI-powered scheduling automatically assigns pilots based on their license level, qualifications, and availability—minimizing manual effort and reducing scheduling conflicts.

2.2 Personal Dashboard

Gives pilots a clear view of upcoming assignments, including boarding times, ship details, and port information. It also provides live weather updates and forecasts to help pilots prepare for changing conditions. With real-time alerts and a mobile-friendly design, pilots can stay informed and ready, ensuring smooth, efficient, and safe operations.

2.3 Real-Time Ship

The app integrates with a to show live locations of vessels approaching or departing the port. Filters allow users to display specific vessel types such as cargo ships, tankers, passenger liners, or fishing boats for better planning and resource allocation.

2.4 Anchorage Data

The “Anchorage Data” tab provides detailed tidal data including today’s and tomorrow’s high and low tide times specific to each port (e.g., Kampung Pasir Gudang). Live weather updates help pilots prepare for changing maritime conditions and improve safety.

3. PRODUCT USAGE

The PilotHub app is designed to be user-friendly and modern, making it easy for pilots and port staff to use. Users log in with a unique ID and password to keep their information secure. After logging in, they see a dashboard with upcoming assignments and ship tasks. In the pilot booking section, users can search for ships by entering the ship ID, license type, ETA (Estimated Time of Arrival), and ETD (Estimated Time of Departure). AI helps match pilots to ships based on their qualifications. The personal dashboard also shows weather updates, assignment details, and ship information. A real-time tracking page lets users follow ship movements live. The anchorage tab provides tide information based on port location to support accurate scheduling. PilotHub improves communication and coordination between key port stakeholders—like port authorities, marine agents, and pilots.

4. SURVEY AND FEEDBACK

We received great feedback from the community about PilotHub, showing strong interest in the app. To better understand user needs, we ran surveys using Google Forms. The survey focused on whether people wanted a tool that could improve their pilotage experience, thus helped us design more user-friendly features and make PilotHub more effective to use.

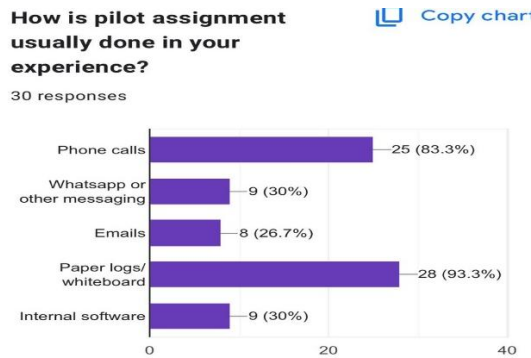


Figure 1: Questionnaire

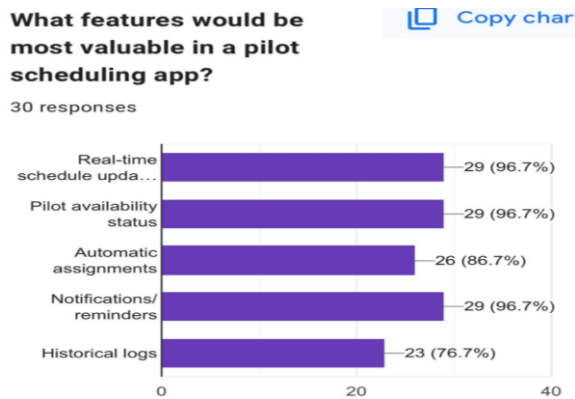


Figure 2: Questionnaire

5. COMMERCIALIZATION POTENTIAL

5.1 Potential for Commercialization

The commercialization journey will focus on how PilotHub's features help in figuring out predicament in port industries as this AI platform will solve real-world problems for these stakeholders, ultimately leading to increased efficiency, optimized operational performance, safety, and cost saving. PilotHub presents strong commercialization potential by directly addressing key challenges in the port industry through its innovative AI-driven features. The platform enhances efficiency and reduces costs by using AI for smart pilot assignments and streamlined communication, which shortens vessel turnaround times and boosts overall productivity. Its AR navigation and digital log features significantly improve safety and resilience, helping reduce human error and the risk of maritime accidents. By integrating cutting-edge technologies, PilotHub supports operational excellence, enabling port authorities to modernize their systems and improve their global competitiveness. Additionally, the platform's data analytics tools empower port operators to make informed, data-driven decisions by identifying performance gaps and optimizing resource allocation. The app also minimizes delays and eliminates paperwork through digital automation, resulting in a seamless, faster, and more reliable pilotage process for all stakeholders involved.

5.2 Benefits to End Users

PilotHub benefits multiple stakeholders in port operations by streamlining processes and enhancing coordination. For pilots, it offers improved navigation and scheduling through AI-based assignments, live ship tracking, mobile accessibility, and digital log submission, reducing paperwork and enhancing safety. Port authorities gain real-time updates that improve communication with pilots and agents, while data insights support smarter decision-making and seamless integration with existing systems. Marine agents can monitor vessel movements, manage port entry and clearance, and receive accurate ETA/ETD updates. Real-time collaboration with pilots and port staff improves planning, reduces delays, ensures compliance, and leads to significant cost savings.

6. CONCLUSION

PilotHub presents an innovative, tech-driven solution to modernize marine pilotage operations by addressing common challenges such as inefficiencies, delays, and lack of transparency. By integrating AI for scheduling, AR for navigation, and digital tools for compliance, it significantly improves safety, communication, and operational performance in port management. The positive feedback from stakeholders and the potential for global scalability highlight its commercial viability, making PilotHub a valuable contribution to the future of maritime logistics.

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Chapter 51

Improving Students' Mastery in Finding Stationary Points

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ABSTRACT

Stationary points play a vital role in mathematical analysis, particularly in the study of optimization and understanding the behaviour of functions. A stationary point in mathematics is defined as a point on a curve where the derivative is equal to zero. This concept is crucial for identifying local maximum, minimum, and inflection points, and is widely applied in real-life problem solving. In the context of matriculation-level mathematics, understanding how to find and classify stationary points is a key learning outcome in the "Application of Differentiation" topic. Despite its importance, many students struggle with mastering this concept. Reflections from previous teaching experiences revealed that over 75% of students had difficulty identifying and analysing stationary points correctly. Among the factors contributing to this issue were ineffective teaching methods, the absence of clear, structured techniques, and a lack of student engagement in the learning process. This research aimed to identify the root causes of the problem and propose a practical solution to enhance student understanding. The study involved 169 randomly selected students from the Computer Science Department under the Two-Semester System. Data collection was conducted using observations, interviews, and a set of pre- and post-tests consisting of subjective questions. To overcome the identified challenges, a mnemonic-based innovation called DOXYJA was introduced. This method uses a simple acronym to guide students through the steps of solving stationary point problems systematically. The findings showed that DOXYJA significantly improved students' understanding and performance. It also encouraged better organization of their working steps and boosted their confidence in solving differentiation-related problems

Key Words: DOXYJA, Stationary point, Mnemonic, Differentiation

1. INTRODUCTION

Mathematics is a critical foundation in higher education, supporting disciplines such as engineering, economics, and the sciences. However, students entering university often possess diverse academic backgrounds influenced by varying curriculum standards, instructional quality, and exposure to mathematical concepts. These disparities can impede

their transition into more abstract mathematical thinking, making the matriculation phase vital for addressing foundational gaps.

Differentiation, particularly the application of the first derivative in analyzing functions, is a key challenge in university-level calculus. Differential calculus is essential for developing critical thinking and problem-solving skills (Omoniyi, et al., 2025). The first derivative helps identify stationary points, where the rate of change of a function is zero, and is crucial in determining local maxima, minima, and inflection points. Mastery of this concept requires both procedural fluency and an understanding of how derivatives reflect function behavior. Many students struggle with derivative rules due to limited practice and a shallow understanding of earlier concepts.

This study explores how students' academic backgrounds influence their comprehension of stationary points and derivative application, aiming to identify misconceptions and inform targeted instructional strategies.

1.1 Focus of the Study

The focus of this study is to assist 169 students from the Computer Science under the Two-Semester System at Negeri Sembilan Matriculation College in mastering the technique of solving questions related to finding stationary points using the DOXYJA method. DOXYJA is a method developed by a lecturer as an innovative approach to teaching and learning in the Mathematics course. This method utilizes a mnemonic acronym strategy to guide students through the process of solving stationary point problems systematically. Mnemonic strategies are used in various ways. They are employed by teachers whenever important information needs to be remembered by students (Kleinheksel, K. A. et al., 2003). It is anticipated that the DOXYJA approach will help students obtain full marks in questions involving stationary points and, consequently, improve their overall performance in the Mathematics course.

1.2 Problem Statement

Students face several challenges in mastering the steps required to determine stationary points. These issues include:

- i. Inability to write systematic and organized working steps, often omitting crucial steps in the process of finding stationary points.
- ii. Difficulty in providing accurate final answers.
- iii. Confusion about the requirements of the question whether to find the stationary points or to determine their nature.
- iv. Struggles in remembering the method or sequence of steps needed to solve stationary point problems.

1.3 Research Objectives

1.3.1 General Objectives

The general objective of this study is to enhance the teaching practices of lecturers at matriculation colleges while improving students' achievement in the Mathematics course. Ultimately, this approach aims to contribute to a higher percentage of students attaining Grade

A in the Mathematics subject in the Matriculation Programme Semester Examination. The DOXYJA method is designed not only for use by matriculation lecturers but can also be effectively applied by secondary school teachers in the teaching and learning of Additional Mathematics, particularly under the Form Four topic of Differentiation.

1.3.2 Specific Objectives

The implementation of this innovation is guided by the following specific objectives:

- i. To ensure students can write clear, structured, and systematic working steps when solving for stationary points.
- ii. To enable students to provide accurate and complete final answers.
- iii. To help students better understand the requirements of the question.
- iv. To assist students in remembering a simplified and effective method for solving stationary point problems.

2. LITERATURE REVIEW

The following section presents the literature review for this study, providing a discussion of previous research, theoretical perspectives, and key concepts that form the foundation and context for the current investigation.

Myers, D. E., (1989) said that stationarity, in one form or another, is regarded as an essential characteristic of the random function used in geostatistical practice. Unfortunately, the term is often misunderstood and misused. While not all ambiguities or disagreements can be resolved in this presentation, an overview is provided and a standard terminology is proposed, so that a common basis for communication can be established among practitioners. The importance of stationarity is reviewed, and distinctions between its various forms are illustrated through selected examples.

The subject of differential equations is recognized as vast, diverse, and highly valuable across numerous disciplines. Differential equations are often studied independently due to their intrinsic mathematical interest, or they may be examined by professionals such as physicists, engineers, biologists, economists, physicians, or political scientists, as they can be used to model and quantitatively explain various physical and abstract systems. A differential equation, in which y is treated as the dependent variable (or unknown function) and x as the independent variable, is typically expressed in the following form:

$$F\left(x, y, \frac{dy}{dx}, \dots, \frac{d^n y}{dx^n}\right) = 0$$

for some positive integer n . When n equals zero, the equation is no longer considered a differential equation but is instead classified as an algebraic or transcendental equation (Ross, C. C., 2004).

3. METHODOLOGY

This study was conducted using a classroom-based action research approach, as proposed by Cain, T. (2011), with the aim of improving students' understanding of stationary point

problems through the DOXYJA method. In the first phase, students received a conventional lecture on stationary points using standard teaching methods. They were then given a set of practice questions. The results of this pre-test indicated that many students struggled to follow correct procedures or provide accurate final answers.

In the second phase, students were introduced to the DOXYJA method, a mnemonic-based strategy designed to guide them through the solution process. A specially prepared instructional video was shown, and the lecturer provided step-by-step explanations to reinforce understanding. After the intervention, a post-test consisting of similar questions was administered to assess improvements in performance and procedural clarity.

Data were collected from four practicum classes to ensure a representative sample. Student performance was compared using average scores from both tests. Additionally, students were grouped into weak, average, and excellent categories to evaluate achievement levels. Standard deviations were analysed to assess consistency within each group. The data were analysed descriptively to observe trends, determine improvements, and evaluate the effectiveness of the DOXYJA method in enhancing students' systematic approach to solving stationary point

4. RESULTS AND DISCUSSION

A significant improvement was observed in students' ability to solve stationary point questions based on pre- and post-test comparisons. Initially, complete solutions were seldom produced. Following the introduction of the DOXYJA method, more structured approaches were adopted, and many full marks were attained, as illustrated in Figure 1.

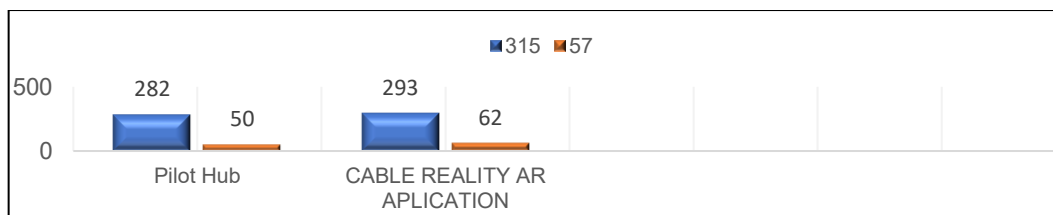


Figure 14: Comparison of The Number of Students Who Obtained Full Marks (12 marks) In Finding a Stationary Point between Practicum Classes

Students were grouped as weak, average, and excellent. The greatest improvement was observed among weak and average students, whose understanding and confidence increased markedly. Even excellent students displayed refined working and greater precision, as illustrated in the post-test results in Figure 2.

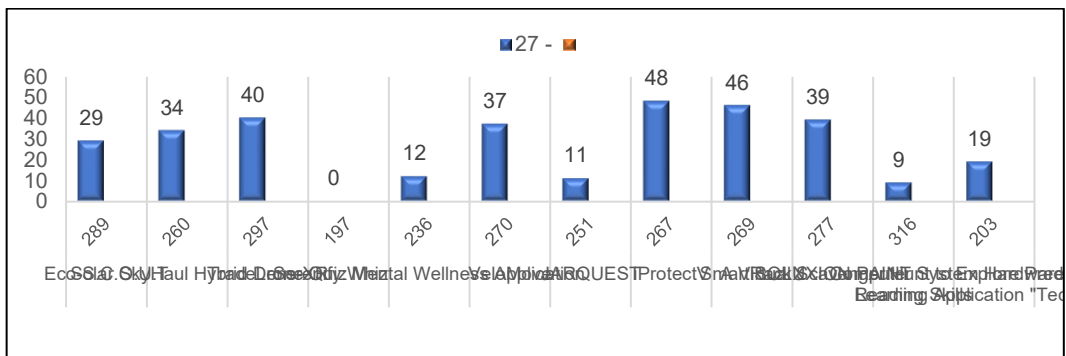


Figure 2: Comparison between The Number of Students by Achievement Level Category for Each Practicum Classes

Table 1 shows a reduction in standard deviation between pre-test and post-test scores observed in all four classes. This indicates a narrowing of the performance gap among students, suggesting that the DOXYJA method helped create a more balanced learning outcome across different levels of ability.

Table 4 Standard Deviation for Pre Test and Post Test between Each Practicum Classes

PRACTICUM CLASS	STANDARD DEVIATION	
	PRE TEST	POST TEST
K1T1	4.46	3.57
K1T2	4.27	3.15
K1T3	4.49	3.13
K1T4	4.71	3.60

5. CONCLUSION

This study found that the DOXYJA method significantly improved students' ability to solve stationary point problems in differentiation. It enhanced their solution clarity, accuracy, and confidence, especially among weaker learners. The method's structured, mnemonic-based approach also promoted greater classroom engagement and highlighted the value of student-friendly mathematics instruction.

6. RECOMMENDATION

Based on the study's findings, several recommendations are made to enhance the DOXYJA method's effectiveness and broaden its application. First, the method should be introduced in other matriculation colleges and secondary schools, especially in Mathematics and Additional Mathematics courses covering differentiation. Second, professional development programs, such as workshops and training sessions, should be implemented to ensure educators have the skills to apply the method effectively. Third, the method can be enhanced by integrating digital tools, such as instructional videos, interactive presentations, and online quizzes, to improve student engagement. Finally, further research should investigate its effectiveness across other mathematical topics and include a larger, more diverse sample.

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Chapter 52

The Waste-to-Energy Concept

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ABSTRACT

Malaysia is currently facing a serious problem with solid waste, especially in cities where landfill space is running out. Due to a lack of environmental understanding and concern, this country also struggles with improper trash disposal by people. This method breaks down biodegradable waste to produce methane gas, which can be used to generate electricity through a turbine. The research also suggests involving communities through small-scale biogas systems, and awareness campaigns. This approach helps reduce pollution, manage waste better, and supports Malaysia's goal of becoming more sustainable.

Key Words: *Waste-to-Energy, Biogas, Renewable Energy, Solid Waste Management, Malaysia*

1. INTRODUCTION

Waste management systems in Malaysia have not improved generally with the increase in waste generation due to urban and population growth. According to our observation, although the waste disposal literacy has spread widely to the community, however, the practical level of it in their daily routine is still low. As a result, overflowing landfills, and insufficient waste is being recycled can lead to a risk ecosystem and human health. Therefore, we have come up with an innovative solution to solve this matter that provides benefits in the long term. Our innovation focuses on how anaerobic digestion, a waste-to-energy method, can help solve this issue by having this system be put in place in a university. This method turns food waste and other organic material to decompose, which releases methane gas which then powers the turbine to generate electricity and reduce the amount of waste that ends up in landfills.

2. LITERATURE REVIEW

The idea of waste-to-energy (WTE) originated from the increase in waste disposal concerning Malaysia to face significant challenges in waste management. Only a few of the landfills located in Malaysia are designed to minimize the environmental damage which is not enough to eradicate the huge amount of waste sent to the landfills. The Waste Management Association of Malaysia (WMAM) has warned Malaysia will be at risk of running out of landfills by 2050. Hence, 174 landfills reported to have been closed due to prevention of environmental contamination costing the government over 1.6 billion annually since 2015 (December 2023, K. Harinderan). Therefore, WTE is a great initiative created to solve this issue for a long term beneficial to both government and society. WTE is a method of converting solid waste into usable energy like electricity or heat through technologies such as incineration, gasification, and anaerobic digestion. It helps reduce landfill use, lowers greenhouse gas emissions, and recovers energy from non-recyclable waste. WTE can be expensive and raise environmental concerns if it is not properly managed. Based on our research, a few countries such as Sweden, Japan, Denmark, and the United States have implemented this innovation. Malaysia can also get benefit by this innovation reducing the total waste from 82% to the lowest percentage such as Sweden impressively reduce its waste at 4% end up in the landfill (April 2019, Dr Prem Jagyasi and Team).

3. METHODOLOGY

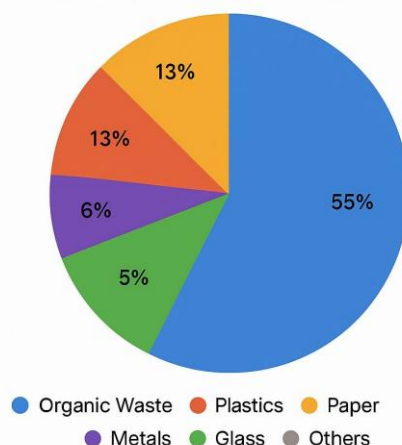
This research is based on information collected from previous studies and data about waste generation and management in Malaysia. It also uses a proposed model of a decentralized anaerobic digestion system. The idea is to introduce small-scale biogas units in local universities to process organic waste directly. This would reduce the pressure on public collection systems and allow for faster waste processing. Other parts of the method include promoting public education, giving rewards for waste separation, and improving student involvement in waste management.

4. STUDY AREA

The focus of this study is on highly populated urban areas in Malaysia such as UiTM Puncak Alam, Selangor. These places generate a large amount of waste daily and high energy demand for industrial uses and residential. These areas are suitable for introducing small-scale waste-to-energy systems because of their high waste production and community potential for participation in energy recovery.

5. ATTITUDE OF PEOPLE AND ITS EFFECT ON THE ENVIRONMENT

Currently, waste is collected once or twice a week by municipal authorities. A lot of people are not aware of how poor waste disposal affects the environment. Some people throw garbage illegally such as throwing it into drains, open spaces, or burning due to lack of collection services or awareness which causes pollution and health problems. Without strong public awareness and education, it will be hard to implement waste-to-energy systems. Changing public attitudes is very important for these systems to succeed.

Household Waste Composition in Malaysia

6. RESULT AND DISCUSSION

In UiTM Puncak Alam, household waste is produced every day i.e. cafeteria and residents of UiTM Puncak Alam. Most household waste is made up of biodegradable materials like food waste, vegetables, and paper. This kind of waste is suitable for anaerobic digestion. Plastics, metals, and glass make up a smaller part of the waste and can be recycled through other channels. If organic waste is separated properly, the amount of waste available for biogas production will increase, less waste will go to landfills and more electric can be produced due to the high traffic of waste

7. RECOMMENDATION AND CONCLUSION

Waste-to-energy using anaerobic digestion is a practical and sustainable way to manage Malaysia's growing waste problem. It not only reduces landfill waste but also provides clean energy. To make this system work, it is important to involve the public, promote waste separation at home, and build small-scale biogas systems. With proper education and university support by providing funding and awareness programs, this waste-to-energy system can work effectively in many parts of the country and contribute to a greener future for UiTM. Since UiTM is also aligning their mission with ours to reduce carbon emission in 2030 by 45%, it would be very beneficial if it could be implemented on a university campus with the help of UiTM management to oversee the output.

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Chapter 53

Smart Mirror Integrated with Health Insights: Enhancing Personal Wellness Through Real-Time Health Monitoring

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ABSTRACT

In today's fast-paced lifestyle, many individuals, especially adults, often ignore their physical and emotional health due to time constraints, lack of awareness, and the inconvenience of using separate health monitoring tools. To address this issue, our group has developed an innovative concept product called Smart Mirror with Health Insights. This smart mirror is designed to provide real-time health insights and mental wellness support in a seamless and user friendly way. This smart mirror combines multiple technologies into one simple mirror. It includes sensors that monitor vital signs like heart rate and temperature, as well as a facial recognition system that detects the user's emotional state and skin condition. What makes this mirror unique is its Calm Space Mode technologies, which automatically activates when the user appears stressed or anxious. The mirror will offer calming sound, soothing music, and positive affirmations. The mirror also displays gentle daily reminders and motivational quotes to support mindfulness and emotional well-being. Additionally, users can set personal goals (such as hydration and steps) and receive ongoing encouragement through the mirror interface. Its eco-friendly design also reflects a sustainable approach to wellness technology. Our goal is to integrate health monitoring into everyday life without the need for multiple apps or devices. This mirror aims to promote healthier habits and improve quality of life through everyday interactions. This concept not only supports physical health but also addresses emotional needs. By integrating smart technology into a familiar object, it promotes self-care in a simple and practical way.

Key Words: smart mirror, wellness, mental health, daily reminders, health technology

1. INTRODUCTION

The fast-paced world of today has never made personal well-being more important. The Smart Mirror with Health Insight is a revolutionary product which brings healthcare to the home by combining real-time health tracking with a smart reflective surface. The product tracks key health metrics like body temperature, heart rate, BMI, and facial fatigue and stress indicators through in-built sensors, artificial intelligence, and data visualisation software. With an instant feedback in the guise of a mere stand before a mirror, shoppers receive data analysis of their health figures at that moment, and become an integral part of routine life. Easy to use, discreet, and convenient, the intelligent mirror nudges customers toward healthy behavior and informs customers of their own healthcare. Its enabling technology, in essence, is designed to close the gap between lifestyle and health care and facilitate healthy living with seamless, intelligent integration.

2. LITERATURE REVIEW

A literature review is a collection of new and existing research and studies about a product or topic. The review is intended to identify what needs to change or what needs to be improved in an effort to enhance the product compared to those that already exist. Based on learning about previous research, the review helps us figure out how the product is produced, what materials are used, and what method is followed. The main objective is to determine whether the product meets customer's demands and needs, or does have any lack. For that, the review uses various research methods, survey, observation, and the analysis of existing products. The information is extracted from various resources, such as websites, scientific publications, and expert or user interviews. After we have compiled all this information, the review also takes into consideration the strengths and weaknesses of the product or topic. By observing both the positives and negatives, we can come up with ways to better the product and make it better for consumers. Understanding what customers actually need is the key to getting past any hindrances and developing a product that works well for them.

3. METHODOLOGY

This methodology focuses on the entire process of creating the product concept of the Smart Mirror with Health Insights. Our main goal was to develop a product that will assist users in improving their physical and mental health in their daily life. We want to create an innovative product concept that is practical and relevant to working adults. We started by identifying the main issues that many working adults deal with. According to the observations and discussions, we found that most people often feel tired, stressed, and unable to keep track of their health due to busy schedules. As a result, we were able to identify what was needed and the challenges of our target users.

To generate ideas, we then had a brainstorming session. Our goal was to create something useful, applicable, and a part of daily life products. At that point, we had the idea to transform a standard mirror into a smart wellness tool. This is because people use mirrors in their daily routine. By adding smart features to it, we can assist working adults enhance

their well-being without disrupting their daily routine. Next, we develop the concept of wellness by listing down important features such as health tracking (heart rate, skin condition), AI-Emotion Detector, AI-Powered Personalization, Calm Space Mode technologies, daily affirmations and wellness reminders. All these ideas were combined into one smart mirror concept.

Lastly, we also shared our concept with a few students and working adults to get their opinions. Their feedback helped us improve the features and ensure the product would be user friendly and suitable for real life use. This approach made it possible for us to create a product that fulfills actual demands while coming up with a unique idea. In addition, we discussed how to raise awareness about the product. Since our target users are working adults who spend a lot of time online, we plan to promote this smart mirror mainly through social media platforms, influencer marketing, and digital advertisements. These channels are effective in reaching busy individuals and can help highlight the benefits of our product in a relatable and engaging way.

In conclusion, this methodology reflects the full product making journey. From identifying the problem to forming an innovative and user-friendly solution. We used creative thinking and simple tools to design a product that meets real wellness needs.

4. RESULT AND DISCUSSION

4.1 Result

The evolution of the concept for the Smart Mirror with Health Insights revealed a strong desire for well-being tools to assist working individuals. Our research, as well as casual chats, revealed that the majority of the population is stressed and exhausted as a result of their hectic schedules. This verified the existence of a product that was health-focused and could be smoothly integrated into daily routines.

Aside from that, the answer involved creating an original yet familiar smart mirror wellness device by changing a standard mirror. Clinicians may now use a single device as a multi-functional tool thanks to heart-rate monitoring, emotional detection, and Calm Space Mode technologies, which enable complete self-care. Reminders about wellbeing, personalised goals, and affirmations helped users maintain a healthy lifestyle.

We presented the concept to our students and other working adults, receiving quite useful feedback. Most of them liked the idea of combining wellness technology with an object that is already in use, considering it easy to use. From their suggestions, we incorporated additional features that enhanced them to meet the expectations and needs of the users.

4.2 Discussion

We also identified prospective markets for the Wellness Glass. Given the growing interest in smart home gadgets and personal health technology, this product is relevant to today's markets. Nonetheless, its success will be dependent on precise, user-friendly metrics, a simple design, and a robust digital advertising campaign. Marketing on social media and endorsements from wellness influencers would aid in promoting the product and reaching the

intended demographic. Glass's ergonomic design has the potential to revolutionise user access to wellbeing. It creates a user-friendly gadget, a modern method to improve lifestyles while actively attending to health concerns.

5. CONCLUSION AND RECOMMENDATION

In the end, the smart mirror is not just a reflection. It is a personal wellness companion integrated with health insights assisting the users in health awareness, making it a real-time and relevant product with innovative technology. Through emerging market feasibility and financial viability emphasizing the development efforts will sustain the brand reputation to launch a successful product with the best quality and high demand in the market. However, success will depend on providing accurate, user-friendly features and conveying the value of the product effectively through targeted marketing.

To ensure the product's success, it is advisable to enhance user experience by giving utmost priority to product design in simple and user-friendly interface, with features like voice recognition, privacy options and app syncing to heighten user satisfaction. Apart from that, it is also advisable to concentrate on digital marketing through collaborative alliances with health-conscious or fitness influencers in illustrating product benefits in real-time on social media platforms like Instagram and TikTok. This indirectly builds awareness and also educates the followers about how the product works effectively. Last but not least, the control of component costs should be prioritized too, especially the costs related to key hardware components such as AI personalized features and smart displays to ensure the final product remains competitively priced without compromising quality.

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Chapter 54

Non-Suitable Area Detection for Ports and Harbour Construction Alongside Coastal Water Using Remote Sensing Approach

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ABSTRACT

The intertidal zone, being an interface between terrestrial and marine environments, is very susceptible to environmental changes like sea level rise, coastal erosion, and human activities. They have direct repercussions on biodiversity, marine ecosystems, and socio-economic activities, mainly for the locals who depend on tourism and fishing. Through an understanding of the spatial and temporal intertidal zone variations, this study also hopes to enlighten us about the degree of coastal transformation with time. The aim of this study is to identify changes in the intertidal zone that is unsuitable to be constructed as port or harbour using satellite remote sensing data between 2016 and 2023 in the Perlis coastal area.

Key Words: intertidal zone, remote sensing, area detection, marine environment

1. INTRODUCTION

Malaysia is an ocean nation with a beautiful coastline that attracts tourists from both domestic and international travel. Highly productive habitats like mangroves, coral reefs, seaweed, and marine ecosystems can be found in the nearby coastal areas. Because of the coastal area's diversity and richness, addressing difficult environmental concerns requires an integrated strategy in order to build a place that is sustainable and well-preserved. The evaluation of the current intertidal zone including ecology, biodiversity, marine life habitat and so on becomes a reference to evaluate changes over time. The trends and patterns of sea level rise involve the use of data from tide gauges as well as satellite observations and further sea level rise over the intertidal zone may increase erosion, changes in sedimentation patterns, subsidence of low areas within habitat boundaries. Thus make this area not suitable to be choose as port or harbour.

Tides in port have a significant impact on fishing vessels. Among them is experiencing problems during the voyage when the tide is low, the water level drops and the depth in the port decreases. This makes it difficult for ships to navigate, especially large ships that need greater water depth and are easy to enter and leave the port. Furthermore, ships sailing in or out of port at low tide have a greater risk of running aground due to the reduced water depth. This can cause damage to the ship and requires more intensive precaution & security aspect. Research objectives:

- i. To identify the location of the intertidal zone at coastal area using remote sensing approach.
- ii. To analyse the intertidal zone between two different years to see the changes in term of it size.

2. LITERATURE REVIEW

Different geomatic techniques are employed to locate and chart the intertidal regions. For examples, multispectral satellite imagery, like Landsat or Sentinel satellites enables comprehensive surveillance of intertidal regions by examining the spectrum of light reflected from the Earth's surface allows for the classification of intertidal zones according to spectral variations, like the differentiation between areas covered by water and land. Mao et al. (2022) has employed the Normalized Difference Water Index (NDWI), which aids in distinguishing water-covered regions from land, rendering it especially beneficial for evaluating intertidal zones during different tidal stages. This information also enables spectral analysis of regions revealed at low tide and regions submerged at high tide. On the other hand, Sentinel-2 provides excellent spectral resolution through bands like red, green, blue, and infrared, which aid in recognizing various vegetation types and intertidal environments like mangroves and seagrass (Muir et al., 2024).

In unsupervised image classification, the process involves identifying each image in a dataset as belonging to one of the natural categories found within the image collection, without the use of labelled training samples. Unsupervised image categorization depends on the application of unsupervised machine learning algorithms. This article recognizes clustering algorithms and dimension reduction algorithms as two essential types of unsupervised machine learning methods required for unsupervised image categorization, along with how these methods are applied in notable implementations of unsupervised image classification techniques. Because unsupervised image categorization can facilitate classification without training samples, it has been recognized as a method for enhancing visualization and retrieval efficiency in image retrieval (Datta, et al, 2008; Datta, Ghosh & Ghosh, 2015). It has also been recognized as a method for correlating low-level features with high-level semantics, particularly in applications driven by learning (Huang & Zhang, 2012). These attributes render unsupervised image classification a plausible approach for closing the semantic gap in image retrieval (Wang, Mohamad & Ismail, 2010).

Extraction of water bodies has been performed employing numerous spectral-based indices for water and vegetation, such as the Automatic Water Extraction Index (AWEI) (Feyisa et al., 2014; Kareem, Attaee & Osman, 2024), Normalized Difference Water Index (NDWI) (Xu, 2006), Modified Normalized Difference Water Index (MNDWI) (Xu, 2006;

Amoroso & Figliomeni, 2023). Nonetheless, particularly in estuaries or bays, this metric does not reflect tidally flooded salt marsh plant life. To reduce this effect, Zou et al. (2017) developed a technique incorporating vegetation and water indices, which was subsequently utilized by Chang et al. (2022) to monitor tidal flat alterations each year on a national scale.

3. METHODOLOGY

This research employs a quantitative method utilizing satellite images to examine alterations in the intertidal area along the Perlis shoreline. The approach consists of three key phases: obtaining data, processing data, and performing analysis with ArcGIS Pro and Erdas Imagine 2014.

3.1. Data acquisition and Processing

This research utilizes three datasets of Sentinel-2 satellite images captured during high tide in January 2016, March 2023, and April 2023 to investigate temporal changes in the intertidal zone. These datasets enable us to examine long-term variations (2016 and 2023) and explore short-term variations (March 2023 and April 2023), providing insight into both gradual and recent shifts along the coastline. The high spatial and multi-spectral resolution of Sentinel-2 allows for precise identification of water coverage, making it suitable for observing tidal variations, sea level increase, and coastal degradation. Through the examination of these datasets, the research will determine the degree of tidal expansion, possible environmental effects, and factors like climate change, extremeweather occurrences, and sediment realignment that affect coastal dynamics and the stability of intertidal habitats.

The data processing procedure in this research intends to methodically identifying the intertidal zone in the Perlis coastal region utilizing ArcGIS Pro and Erdas Imagine 2014 software. This data processing includes several key steps executed in order to guarantee the accuracy and dependability of the analysis outcomes. Data from the Sentinel-2 satellite is analyzed to derive information on high water zones and low water zones, and tidal data is utilized to aid analysis to fulfill specified criteria. The steps for data processing encompass image filtering, classification, water index computation, along with digitization and overlay for the comparative analysis of the intertidal zone across different timeframes, specifically in January 2016, March 2023, and April 2023.

3.2. Unsupervised Classification Using ISO Clustering

Unsupervised classification is a key step in processing satellite image data to identify the intertidal zone. In this research, the ISO Cluster method, an automated classification technique that requires no user intervention, is employed to analyze complex spectral data for the Perlis coastal region. Data from Sentinel-2 satellite images, which have undergone the Layer Stacking process, serves as the primary input. Important spectral bands, including the green and near infrared (NIR) bands, were selected due to their sensitivity to water characteristics and wetland regions. These bands assist in differentiating land regions, water, and the intertidal zone according to their reflectance values. A suitable unsupervised

classification algorithm is chosen to group image pixels according to their spectral values. Two frequently utilized algorithms are K-Means Clustering and ISO Clustering (ISODATA). K-Means Clustering divides the image into multiple clusters according to spectral similarity, aggregating pixels with alike spectral characteristics into the same group. After identifying the intertidal zone, a map of this area is created utilizing Geographic Information System (GIS) tools to examine shoreline alterations, tidal influences, and their effects on the marine ecosystem.

4. RESULT, DISCUSIION AND CONCLUSION

The intertidal zone, which lies between high tide and low tide, is represented with a hatch pattern on the map (Figure 1), signifying areas that have experienced tidal changes over time.

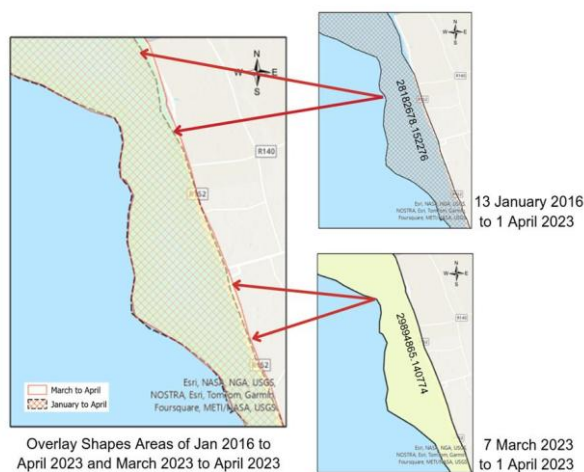


Figure 15: Result of unsuitable area for port and harbour construction classified by remote sensing approaches

The differences in the size of the intertidal zone might result from various factors, including coastal erosion, sediment build-up, or changes to the shoreline from human actions and natural events like storms and increasing sea levels. Regarding the connection between natural factors and human activities, the research effectively correlated changes in the intertidal zone with elements like coastal erosion, sediment deposition, and rising sea levels. Tidal data gathered indicated a drop in high tide measurements from 2.87m in 2016 to 1.84m in 2023, offering proof of shifts in hydrodynamic patterns. The effects of lunar gravity and the northeast monsoon season were also recognized as factors contributing to the phenomenon of stranded ships, providing a practical aspect to this research. The drying height area (green) serves as a critical transition zone between land and sea, acting as a buffer that protects the coastline from erosion. In this image, the drying high can be identified as mudflats or sandbanks near the boundary between the light green (intertidal zone) and yellow (land). This area also acts as a primary pathway for sediment transport from land to sea, influencing coastal dynamics.

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Chapter 55

SmartStats: Digital Statistics Notebook

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ABSTRACT

SmartStats is an advanced platform integrating learning and solving statistical problems with Python. With comprehensive notes and interactive coding examples on Google Colab, SmartStats simplifies statistical concepts and applies them in practical ways. Generally, traditional approaches to statistics education often lack engagement and real-world relevance. SmartStats addresses this by offering a hands-on, accessible learning experience emphasising conceptual understanding and technical skills. With digital notes and coding opportunities, users can explore key statistical methods directly on the digital platform. This approach empowers students, educators, and professionals to build confidence in data analysis and become proficient in applying statistics to solve real-world problems.

Key Words: Statistics, Python programming, online learning.

1. INTRODUCTION

The need for strong programming and statistical analysis skills is rapidly increasing in today's data-centric era. Nevertheless, traditional teaching approaches often fail to promote meaningful understanding and student engagement. Static lectures, textbooks, and minimal hands-on experiences frequently fail to address students' diverse learning styles and needs. This shortfall highlights the urgent need for educational tools that are more interactive, accessible, and tailored to individual learners. Incorporating technology into active learning strategies can significantly enhance student participation, interaction, and overall learning quality (Wibowo et al., 2023; Intan Nur Izzaty Mohd Rosli & Noorezatty Mohd Yusop, 2023). As Python continues to establish itself as a primary language in data science, there is a growing demand for platforms that effectively combine collaborative statistics education with programming. SmartStats responds to this need with an innovative approach. Through

features like streamlined note-taking, practical exercises, and customised learning experiences, SmartStats empowers learners to thrive in the dynamic world of data science.

2. LITERATURE REVIEW

In the 21st century, technological advancements have significantly transformed the teaching and learning process, particularly in data science and statistics. The rapid expansion of online and offline educational environments highlights the increasing demand for effective and engaging teaching tools. Recently, there has been a growing demand for interactive platforms that facilitate efficient data exploration, statistical analysis, and visualisation (Sabuncuoglu & Sezgin, 2023; Fawcett, 2018). Google tools, such as Google Colab, offer valuable online resources for teaching and learning statistical and programming concepts, providing a more accessible and interactive environment for students.

Python, as a programming language, is particularly well-suited for teaching statistics and data science. With its extensive libraries (e.g., Pandas, NumPy, Matplotlib, Seaborn), Python supports interactive data exploration, visualisation, and statistical modelling. Platforms that integrate Python with tools like Google Colab foster an innovative, hands-on approach to mastering data science concepts. They support active learning by providing real-time access to datasets and interactive coding environments. This simplicity reduces barriers to learning complex topics and encourages more active participation.

Integrating innovative tools like Google Colab allows users to develop practical, real-world skills in a flexible and engaging environment. These technologies enhance the educational experience and equip learners with the skills they need to succeed in an increasingly data-centric world.

3. METHODOLOGY

The development of SmartStats follows five key stages to ensure an effective and engaging learning platform. First, content is planned and designed based on statistical topics. Next, the materials are developed using Google Colab, allowing for interactive coding, visualisations, and hands-on exercises. The third stage involves testing the platform with students and gathering feedback through surveys to assess usability and learning impact. Based on this feedback, improvements are made before deployment. Finally, ongoing promotion and updates are carried out to expand its reach and ensure continuous improvement.



Figure 2: SmartStats Development

4. RESULTS AND DISCUSSION

SmartStats utilises Google Colab to provide an integrated approach to learning Statistics and Python programming. The platform was designed to be flexible, allowing learners to progress at their own pace and revisit complex concepts as needed. It provides the necessary tools for students, educators, and practitioners to develop important data analysis skills that can be used immediately in real-world situations. Figure 2 displays the user interface of SmartStats.

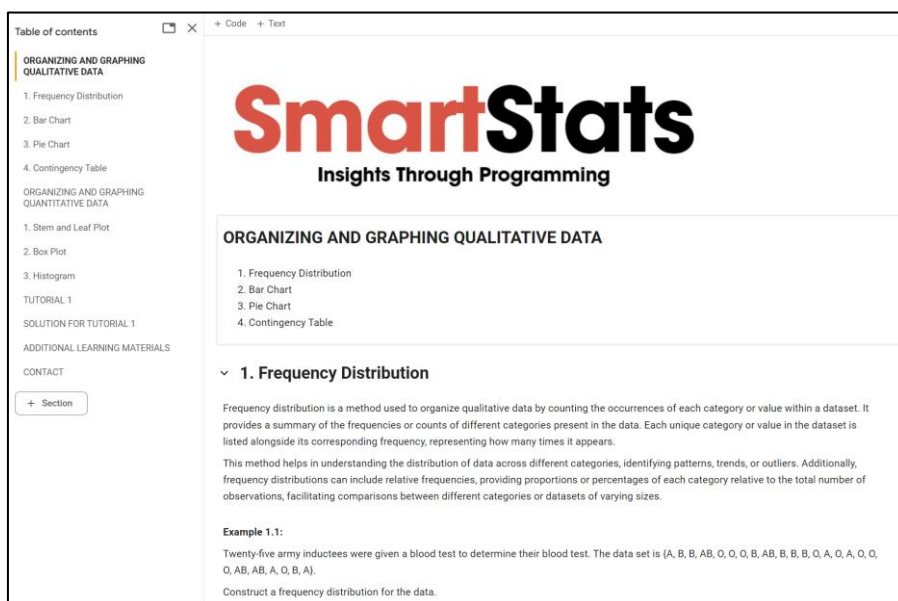


Figure 2: SmartStats User Interface

4.1. Product Features

SmartStats offers a range of educational features designed to support effective learning in statistics and data analysis. The platform provides structured, topic-based explanations that simplify complex statistical concepts for learners. Each topic is complemented by Python tutorials, which reinforce theoretical understanding through practical application. Users could add or modify notes, allowing for a more personalised and flexible learning experience.

Furthermore, all tutorials include complete solutions, enabling learners to verify their work, identify areas for improvement, and strengthen their problem-solving skills.

4.2. User's Feedback

Through a survey conducted by 25 students, the feedback on SmartStats indicates a positive user experience. Most respondents agreed that SmartStats excels in all five evaluated components: interactivity, flexibility, educational value, innovation, and overall usefulness. These outcomes demonstrate that SmartStats effectively meets learners' expectations by providing an engaging, adaptable, and pedagogically valuable tool for studying statistics and programming.

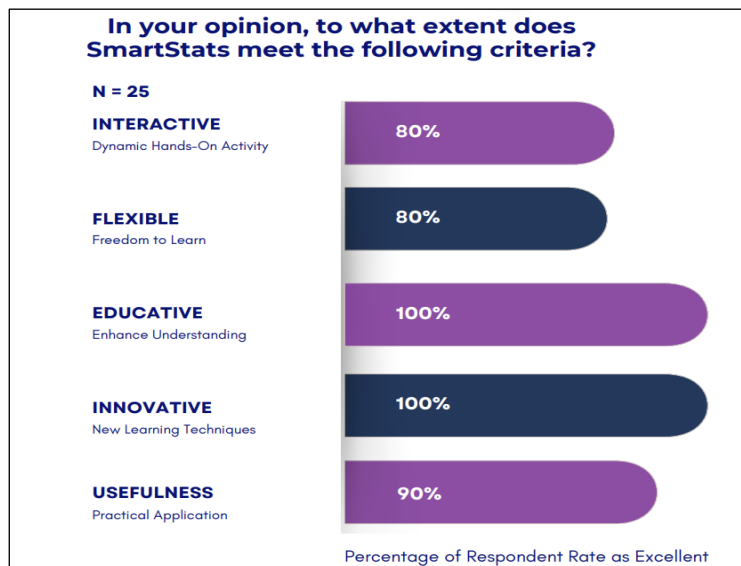


Figure 3: Feedback from users

5. CONCLUSION AND RECOMMENDATION

SmartStats enhances the learning experience by blending theory with hands-on practice through an accessible, personalised, and interactive platform. This approach improves learning outcomes and expands access to data science education for a global audience. SmartStats empowers learners from diverse backgrounds by delivering practical programming and analytics skills. To maximise its impact, SmartStats should integrate real-time feedback, and peer collaboration features. Expanding partnerships with educational institutions and adding multilingual support can broaden its reach. These enhancements foster deeper engagement and help build a more inclusive, data-literate world.

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Chapter 56

Improving Student Life with EZ.B Shoe Dryer

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ABSTRACT

In the monsoon season, people have trouble drying their shoes. Additionally, most people dry their shoes under a fan or behind a fridge. Some people stuff and stuff their shoes with newspaper. Users, especially students, expect the new shoe dryer machine to solve this problem quickly. Students' daily lives inspired our idea. According to brief interviews and questionnaires, many Generation Z students have multiple pairs of trainers and prefer shoes over sandals. They sweat and stink their shoes, especially if they play sports or outdoors. We introduce EZ.B then. Our invention's prototype is a compact shoe rack that holds 2–4 pairs. It quickly and uniformly dries shoes and reduces odour. Despite its size and cost, it is ideal for dormitories and family homes where multiple students can use it. Based on student needs and challenges, this project introduces a new product concept. EZ.B is practical, convenient, and has great potential, especially among young, eager customers.

Key Words: EZ.B, Shoe Dryer, Students

1. INTRODUCTION

Over a day, individuals have consistently encountered difficulties in drying shoes promptly. The EZ.B shoe dryer may just require a brief duration to effectively dry shoes. Utilise this EZ.B while seeking to dry shoes quickly and safely. The purpose of the EZ.B create is to provide a convenient location for individuals to keep and dry their shoes in various conditions. The shoe dryer can be stored anywhere as it operates on a power bank. From the aforementioned remark, it can be inferred that the simple shoe dryer EZ.B serves a significant function as a tool for facilitating the transfer of objects for individuals, hence

alleviating any associated difficulties. The equipment is also potent and silent, utilising thermal action to circulate warm air through footwear, eliminating moisture and odour while safeguarding against harm to boots and shoes. The Shoe Dryer is suitable for several types of footwear, including leather, canvas, vinyl, rubber, plastics, and others. Available in propane variants for residential or outdoor applications, they effectively eliminate moisture, perspiration, and odour from any footwear overnight. Additionally, it enhances foot comfort and wellness.

2. LITERATURE REVIEW

A literature review is an aggregation of contemporary and historical research on a product requiring enhancement to address specific issues. This will allow us to develop superior products compared to those presently available. The study analysed the components, substances, and methodologies employed. The fundamental aim of this research is to ascertain whether the product aligns with consumer preferences and desires, or the opposite. The study employs survey methodologies, observational techniques, and product analysis. Furthermore, data was gathered from many sources, including internet browsing, scientific research, and interviews. A multitude of information is evaluated and referenced. The inquiry may uncover vulnerabilities and advantages of the subjects. We evaluate all advantages and disadvantages to develop a superior, functional product that aligns with consumer requirements. The study presents both advantages and disadvantages. Establishing client demands will resolve all challenges.

2.1 Material of the Shoe Rack

Polypropylene is a prevalent thermoplastic polymer recognised for its adaptability and resilience. It is synthesised via the polymerisation of propylene and is extensively utilised in diverse applications, including packaging, automotive, and textile sectors. Polypropylene is a partly crystalline, non-polar substance exhibiting excellent resistance to chemicals and elevated temperatures. Essential Characteristics and Utilisations:

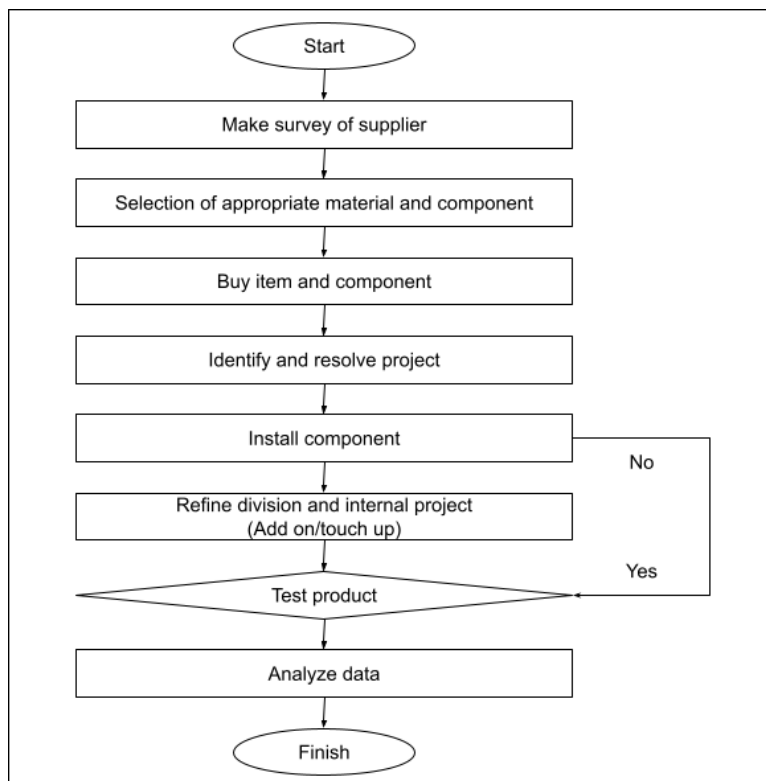
- **Versatile:** Polypropylene may be fabricated into films, fibres, and diverse forms.
- **Robust:** It provides substantial strength, puncture resistance, and chemical resistance.
- **Heat Resistant:** Polypropylene exhibits a high heat distortion temperature, rendering it appropriate for applications involving elevated temperatures.
- **Lightweight:** Polypropylene possesses a low density, rendering it a lightweight material.
- **Packaging:** Extensively utilised for the containment of food, beverages, and various products owing to its moisture and gas impermeability.
- **Additional Applications:** Encompasses medical gadgets, electrical components, and assorted consumer products.

3. METHODOLOGY

The purpose of this study is to determine if the shoe dryer machine we developed can reduce the burden of drying shoes and conserve user time. This chapter also elucidates the criteria for form selection and its influencing elements. This chapter will offer a comprehensive explanation of the study methodology employed for this project.

To guarantee the efficacy of this shoe dryer project, it must be regularly monitored and handled periodically. Our shoe drier can dry several types of footwear, including athletic shoes, leather shoes, school shoes, and further styles, regardless of size. Moreover, manually drying shoes is challenging as it is contingent upon weather conditions, resulting in incomplete drying of the shoe components and the release of an unpleasant odour. Consequently, we developed a shoe dryer that alleviates the burdens of human existence.

3.1. FLOW CHART METHODOLOGY



4. RESULTS & DISCUSSION

Moreover, this Shoe Dryer Machine possesses distinct specifications and design. This project has demonstrated the capacity to address contemporary societal challenges. Nevertheless, the idea will require revisions regarding wiring and material usage in the future. The efficiency

and functionality of this project are the primary aspects that require action. Furthermore, the efficacy of this shoe dryer machine is quite pleasant to users in all respects. This shoe drier is not prone to brittleness and is exceptionally durable due to the high-quality materials utilised and robust installation, ensuring longevity.

5. CONCLUSION AND RECOMMENDATION

The EZ.B shoe dryer is a compact, portable device designed to help students dry their shoes quickly and efficiently. Designed to accommodate 2-4 pairs of shoes, it operates on a power bank and uses thermal action to circulate warm air through footwear, eliminating moisture and odour. The device is suitable for various types of footwear and is available in propane variants for residential or outdoor use. The EZ.B is designed to be practical, convenient, and has great potential, especially among young, eager customers. The shoe dryer is made of polypropylene, a thermoplastic polymer known for its adaptability and resilience. The device is designed to reduce the burden of drying shoes and conserve user time, but requires regular monitoring and maintenance.

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Chapter 57

EasySort App

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ABSTRACT

Global trade depends on sorting operations in export hubs and warehouses, but manual labelling, handwritten notes and verbal directions are some of the old methods that frequently result in mistakes, delays and lost goods. We created EasySort, a clever sorting tool that uses coloured QR codes to improve item management and to solve these problems. Fast visual identification and precise digital scanning are made possible by the fact that each colour denotes a distinct product category or delivery priority. This dual technique cuts down on new hire training time while increasing sorting speed and accuracy. The EasySort software rapidly recognizes the colour of an item when its QR code is scanned, and it gives clear sorting directions. Additionally, the system minimizes human error and streamlines warehouse operations by tracking sorting actions in real time via a connected platform.

Key Word: Smart Sorting, QR Code, International Trade, delivery, warehouse

1. BACKGROUND

EasySort is a smart warehouse solution made to increase logistics accuracy and efficiency, particularly in e-commerce and export hubs. It streamlines parcel sorting by digitally and visually identifying categories such as urgent, local, export, fragile, or large items using color-coded QR codes. This hybrid system improves tracking, decreases errors and simplifies procedures. EasySort makes warehouse management more efficient and dependable by meeting the growing demand for quicker, better-organized logistics as international trade and e-commerce expand (International Centre for Trade Transparency, 2023).

The easy-to-use smartphone app from EasySort provides precise sorting instructions by scanning the QR code of each item. In addition to reading the encoded data, it recognizes the colour of the QR code, which denotes the type of delivery. Its automatic, clear instructions boost staff confidence and save recruit training time. EasySort improves customer

satisfaction by reducing sorting errors and expediting processing to produce faster and more dependable deliveries. These enhancements increase supply chain dependability, which is critical for preserving trust and competitiveness in the fast-paced global market of today.

2. PROBLEM STATEMENT

2.1 Manual Parcel Sorting is Too Slow

During peak delivery periods, such as festive seasons or online sales events, the number of incoming and outgoing parcels can surge dramatically. Manual sorting during such times becomes overwhelmed, resulting in significant processing backlogs. Workers often need to double their efforts to meet deadlines, which leads to fatigue, reduced accuracy, and a higher probability of human error (Gordon, 2024). Furthermore, the time taken to interpret addresses or shipping types for each parcel consumes valuable minutes that could be saved with an automated system.

This inefficiency doesn't just affect sorting; it slows down the entire delivery chain. Late sorting results in missed delivery windows, increased customer complaints, and potential financial penalties from service level agreements. Manual sorting also requires more manpower to achieve acceptable speed, raising labour costs and creating dependency on human availability and consistency.

2.2 Fragile and Oversized Parcels Are Mishandled Without Proper Sorting

Fragile parcels, such as electronics, glassware, or sensitive instruments, require extra care. These items need to be clearly marked, isolated from heavy or sharp objects, and stored in a way that minimizes risk of damage. In a manual system, such parcels are often handled without the necessary caution because the identifiers (like stickers or notes) can be missed, misread, or fall off. As a result, fragile items are more likely to be dropped, compressed under heavier parcels, or stacked incorrectly.

The absence of a smart sorting system means that fragile and oversized parcels are not only mishandled but also misplaced, as their unique requirements are not logged or communicated clearly through the system. This contributes to increased returns, complaints, and lost revenue for courier services (Tomek, 2024).

3. OBJECTIVE

EasySort Apps aims to enhance warehouse efficiency, minimize mistakes during the sorting process, decrease time in the identification of goods, and increase customer satisfaction.

4. NOVELTY

EasySort App is a special application that is created to enhance warehouse efficiency in the warehouse by allowing employees to follow a marked, colour-coded path, which may shorten walking distances, save time finding products by optimising pick routes.

EasySort App is uniquely helpful in minimizing mistakes during the sorting process in the warehouse, as it enables employees to quickly identify item classifications, storage areas, and priority levels. This app may reduce human errors such as mistaken picks and misplaced goods. Hence, the rework and time spent fixing errors are reduced when there are fewer faults.

EasySort App may increase customer satisfaction as there are fewer mistakes during the sorting process and decrease the possibility of sending it to the wrong locations. The goods pass through the system more quickly as warehouse operations become more efficient and well-organized, resulting in on-time delivery. In the end, this degree of efficiency guarantees that the order is processed and delivered without unnecessary delays. Consequently, it results in fewer complaints and returns and improves the overall customer experience.

5. COMMERCIALIZATION POTENTIAL

The need for effective, transparent and sustainable logistics solutions is greater than ever as global trade expands. To handle growing logistical issues, businesses are quickly implementing automated warehouse technologies (The Business Research Company, 2025). To meet this high demand, EasySort has developed a workable and affordable solution that uses colored QR codes to increase sorting speed, lower error rates and provide real-time shipment tracking. Sustainability objectives are further supported by its capacity to reduce paper usage and improve operational effectiveness.

EasySort is specifically designed for target customers such as logistics firms, warehousing companies, and international trade businesses. Its technological feasibility, compatibility with existing systems and scalability make it ideal for organizations seeking to digitize and streamline operations. By optimizing sorting processes and supporting efficient supply chain management, EasySort is well-positioned for commercialization in today's high-volume and data-driven logistics sector.

6. BENEFIT TO COMMUNITY

One of the main benefits of EasySort is its devotion to environmental sustainability. Traditional ways of sorting items frequently include unnecessary handling, repackaging, shipping and sorting errors, which leads to high carbon emissions and packaging waste (Jayasuriya, 2023). EasySort application helps to reduce these inefficiencies by making operations more efficient and eco-friendlier because this application helps warehouse workers to easily classify where the item is stored and where it will be shipped by just scanning the coloured QR codes provided on the items. This not only enables businesses to reduce their environmental footprint, but it is also associated with the global sustainability goals by allowing operations in warehouses to be more eco-friendly.

EasySort not only contributes its benefits to the environment, but it also helps to enhance job opportunities. Instead of having repetitive manual and physically hard labour, the application opens warehouse workers' shifts to more skilled, tech-focused duties. This shift in workers' duties boosts workplace safety and enhances long-term employability through

allowing employees with modern and in-demand skills. The enhancement in workers' growth is critical in today's continuously changing phase in the logistics industry (*Continuous Growth : The Importance of Training, Development and Engagement in the Supply Chain*, 2024).

Furthermore, EasySort allows warehouse firms a more competitive advantage. Firms can meet client requests more efficiently and with consistency because of the app's ability to speed up the process and accuracy of fulfilling orders. This means that the companies can boost customer satisfaction and brand reputation.

Lastly, EasySort contributes to the economic growth it is fostering more powerful industrial and economic growth by strengthening supply chain networks and enhancing resilience to operations. EasySort's implementation into the warehouse operations enable a more agile, efficient and technologically advanced industry and boosting not just the businesses themselves but also the overall company.

7. FEEDBACK FROM COMMUNITY

We used Google Forms to run surveys to get feedback on our application, guaranteeing an in-depth knowledge of it. The total number of respondents for this survey is 40. From the survey, 100% of participants indicated that they are interested in using the EasySort App and agree that this app helps in terms of saving time and would recommend this app to their business partners. 97.5% of participants agree that EasySort App may solve a real problem in the warehouse sector and would be interested in future updates for the app.

Would you be interested in using this app?

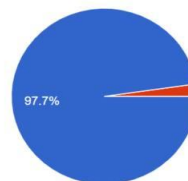
44 responses



● YES
● NO

Would you be interested in future features or updates?

44 responses



● YES
● NO

Do you think that this app solves a real problem in the warehouse sectors?

44 responses



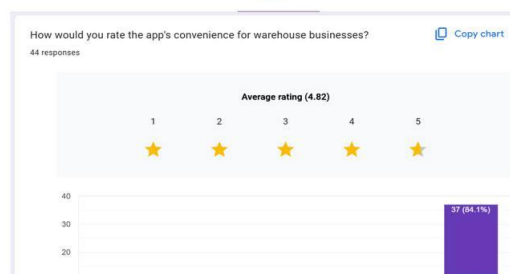
● YES
● NO

Would you recommend this app to your business partners?

44 responses



● YES
● NO



8. CONCLUSION

The EasySort App offers a significant improvement in the logistics and warehouse industries where speed, accuracy, and sustainability are essential to the business success. The app indicates that typical warehouse operations struggle from many problems resulting from their

rely on manual sorting methods. These out-of-date practices cause delays, misplacement of the parcel and continuously handling errors.

The app's goals are to improve efficiency, minimize errors and increase customer satisfaction. EasySort's features allowing a novel approach to the warehouse logistics. The color-code QR system reduces the worker's walking time, fasten up the item identification and effectively categorizes products according to the delivery urgency, fragility and size and other characteristics.

Furthermore, the app allows a high potential for commercialization. EasySort's association with modern logistical needs, economic viability and environmentally friendly operation establish it as an appealing option in rising market. This method promotes paperless sorting, which reduces waste and emissions while increasing warehouse efficiency and transparency. Its appeal extends across variety industries, including logistics businesses, export hubs and e-commerce businesses that are searching to optimize their operations. From the community feedback, Many of the respondents agreed that EasySort addresses a solution for the real problem in the warehouse management.

To summarize, EasySort is more than just an innovative application, it is also a brilliant solution that modernizes the warehouse operations where it helps to increase the productivity of the workers, lowering chances of errors from happening and promotes wider economic and environmental goals. The implementation of the app is an important step towards establishing a more efficient, agile and sustainable supply chain economy.

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Chapter 58

Smart Rest Pillow with Integrated Wellness Features: Promoting Better Sleep and Mental Relaxation

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ABSTRACT

In today's busy world, many people struggle with getting enough rest, managing stress, or simply finding time to relax. Whether it's due to work, study, or daily pressures, sleep and self-care often take a back seat. To help with this, our group came up with an innovative concept product called the *Smartrest Pillow*. This smart pillow is designed to help people relax more easily, sleep better, and feel calmer without needing a bunch of separate gadgets or routines. The *Smartrest Pillow* combines several soothing features into one familiar and comforting item. It has cooling gel memory foam to keep you comfortable throughout the night, built-in Bluetooth speakers to play calming music or nature sounds, and gentle vibrations that help your body unwind like a light massage. There's also an optional aromatherapy feature that slowly releases calming scents like lavender or chamomile to help you fall asleep faster. Everything is controlled through a simple app called *CalmCloud*, where users can adjust settings, track their sleep patterns, and even set reminders for relaxation or self-care. The pillow's soft bamboo fabric and rechargeable design make it both eco-friendly and easy to use. What makes this pillow special is how it turns something as ordinary as going to bed into a peaceful and personalized experience. Our goal is to make stress relief and mental wellness easier to achieve right from your pillow. By bringing together comfort, smart technology, and relaxation, the *Smartrest Pillow* encourages better habits and helps people feel more rested, both physically and emotionally.

Key Words: smart pillow, relaxation, mental wellness, sleep aid, health technology

1.0 INTRODUCTION

Nowadays, many people struggle to get enough rest because of their busy schedules. Whether it's work, school, or daily tasks, people often feel tired, stressed, and uncomfortable. Lack of proper rest can also cause body pain, especially in the neck and back, due to poor sleeping positions. To solve this common problem, we created the Smart Rest Pillow. The Smart Rest Pillow is soft, lightweight, and easy to carry. It gives proper support to your neck and head, making it easier to rest anywhere, anytime. You can use it at home, at your workplace, in the car, or while traveling. It is particularly helpful for students, office workers, and anyone who is always on the go. With this pillow, taking a short break can become more relaxing and comfortable.

2.0 LITERATURE REVIEW

In today's fast-paced world, more people are looking for simple and natural ways to reduce stress and anxiety. One method that's gaining popularity is vibration therapy, which uses gentle vibrations to help the body relax. Along with this, relaxing sounds and calming scents have also been shown to support mental well-being.

Recent studies suggest that vibration therapy can help reduce anxiety, stress, and depression. Saskovets et al (2024) found that vibration therapy helped lower stress hormone levels and improved mood in animal studies. This shows potential benefits for human mental health as well.

In a review of older adults, (Miksis, J.2022) reported that vibration therapy improved energy levels and emotional wellness. Similarly, (Davis, M.2024) found that college students who used vibration therapy showed reduced depression and anxiety, and better overall well-being.

Vibration therapy helps activate the parasympathetic nervous system, which is the body's natural calm mode. Sá-Caputo et al. (2024) explained that this system lowers stress and supports relaxation. Treatment Indiana (2025) also highlighted that regular vibration therapy helps reduce cortisol, the body's main stress hormone, leading to better mood balance. In addition, NeuroLaunch (2024) suggested that vibration therapy may boost serotonin levels, a key brain chemical linked to happiness and calm feelings.

Soothing sounds, such as calming music or nature sounds, have also been proven to reduce anxiety and stress. A 2025 study in the *Journal of Mental Health Research* showed that relaxing sounds can help lower heart rate and stress levels, improving emotional stability (Zhang et al., 2025).

Calming scents also play a powerful role. Lavender, chamomile, and other essential oils have long been known to ease tension. According to the Cleveland Clinic (2024), aromatherapy helps people feel more relaxed and can even improve sleep. Fragrances can create a peaceful environment that supports stress relief when used regularly (Caldwell, E, 2025).

The *Smartrest Pillow* takes all these proven tools, gentle vibration, soothing sounds, and calming scents and combines them into one smart product with other features like cooling

gel and soft memory foam. It's designed to help users relax, sleep better, and improve their overall mental well-being in a simple, natural way.

3.0 METHODOLOGY

This assignment is using an imaginative idea to introduce a stress relief product called the SmartRest Pillow to university students. This assignment focuses on showing how the product helps students feel more relax and reduce stress especially during exam week.

3.1 Target Audience

This assignment is focused on university students, specifically in busy areas like UiTM Puncak Alam. Commonly students often deal with a burden from studies and need ways to release their stress. They are also relied on modern and tech-friendly tools, so a product like the SmartRest Pillow suits their lifestyle.

3.2 Student Habits and Self Care

Many students have a hard time, especially during exams. Some of them don't get enough or don't have breaks while studying. This routine can affect their health and work quality. Not all students know how to handle their stress in a balanced way, so this assignment shows that user friendly tools like the SmartRest Pillow can help.

This innovative product was made to represent real student life and inspire students to take care of their mental health. It sends the point that relaxing and using helpful products is a must for doing well in school and feeling good overall.

4.0 RESULTS AND DISCUSSION

During finals week, we discovered how beneficial the Smartrest Pillow was for assisting us in coping with both mental and physical stress. Many of us initially felt overburdened, irritated, and unable to concentrate, particularly Aishah, who was exhausted. However, we soon realized a difference after using the pillow: the cooling gel and mild vibrations relieved our tense muscles, and the soothing noises from the Bluetooth speakers helped to slow down our racing thoughts. After utilizing it, even Jiha and Ain, who were initially dubious, were pleasantly pleased by how much more at ease and in control we felt.

Like Farisya, the cushion seemed like the ideal complement to our self-care regimens for those of us who already place a high priority on wellness. The transformation of this experience from one of personal relief to one that we wished to share with others was particularly potent. Because of how much it benefited us, we started telling others about it, sharing it on social media, and arguing that it would be a helpful tool for students in times of stress.

All things considered, we discovered that the Smartrest Pillow enhanced not only our physical comfort but also our emotional health, making us feel more at ease, concentrated, and ready for our tests. This experience reminded us of the importance of supporting one

another as well as ourselves and demonstrated how wellness-focused technologies can be helpful in managing academic stress.

5.0 RECOMMENDATION

We strongly suggest the Smart Rest Pillow to students looking for smooth and useful tools to reduce academic stress and enhance their well being after carefully examining user experience and comments. The Smart Rest Pillow is an intelligent and AI-integrated product that goes beyond ordinary comfort in light of the increasing mental health issues that students face today. It actively promotes better sleep, increased concentration and emotional control all of which are essential for both academic and personal success.

Additionally, Our product's transforms from a simple pillow into a smart wellness partner by integrating AI features like guided breathing or relaxing techniques through a linked app, real-time stress monitoring with sensors and individualized sleep tracking. These tools give users practical insights to enhance their mental and sleep health and assist them in understanding their stress patterns.

Last but not least, we advise students to include the Smart Rest Pillow into their self care on a regular basis, particularly during exam season and when they are working on pressure filled group projects. Furthermore, we urge academic institutions and student associations to support the use of smart wellness products like Smart Rest through mental health campaigns, digital wellness initiatives, events, or starting kits. In addition to helping out students to present universities as progressive and student focused.

6.0 CONCLUSION

In conclusion, using the Smartrest Pillow during finals week demonstrated to us how decisive it is to put self care first when dealing with academic stress. A basic curiosity developed into a useful tool that assisted us in coping with our mental and physical stress. When we needed it most, the cooling gel, vibration therapy, and Bluetooth speakers combined to create a calming environment that let us relax, recharge and refocus. Beyond only helping people individually. The cushion also improved our sense of community since we banded together to share its advantages and help one another get through a trying time. Apart from that, taking care of our well-being is not a luxury, it is important for our success and mental health as this experience reminded us.

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Chapter 59

Flexible Piezoelectric Energy Harvester

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ABSTRACT

We produce energy in each of our steps, and in this project, that energy can be measured and used for benefit. This project mainly focuses on the use of a 3D-printed insole for shoes. A piezoelectric film device is integrated into the insole's vital points including the heel, the ball, and the middle of the foot. The piezoelectric film device is made with Polyvinylidene fluoride (PVDF) strips that are less than one millimetre in thickness to provide comfort to users as well as generating energy while walking. The design of the insole is customizable for the best comfort of users. Each capacitance and voltage produced by the steps can be measured by using a standard LCR meter. This project has promising potential for the sustainable energy production in many ways. The insole can also be applicated into healthcare uses, where we can determine the most efficient way to take a step. With an appropriate patent protection, regulatory compliance, and partnerships, this technology can benefit medical facilities, everyday safety, and a cleaner tomorrow.

Key Words: Piezoelectric, energy, 3D, Insole, PVDF.

1. INTRODUCTION

Pressure sensors introduce a significant role in technological advancement nowadays. Beginning with the first invention of simple devices by Evangelista Torricelli in the 17th century, he invents the first barometer in 1643. This device is used to monitor and measure atmospheric pressure using a column of liquid known as mercury (M.P. Mondol.2014). Further advancements are made in pressure sensing, and it evolves rapidly into a more critical component for various industries such as automotive, aviation, and the medical department. After the revolution of the Internet of Things (IoT) in worldwide industries, we see pressure sensors become a demanding sensing element and attract many interests as it proves to be beneficial in healthcare monitoring, smart homes, and industrial production.

Malaysia's conventional way of producing energy is a growing challenge. The dominance of fossil fuels has been the bulk of Malaysia's power generation since decades. It is a general conscious that the use of fossil fuels leaves poisons all over the world, and with the ongoing economy war, we may fall short for whatever it takes to pay the cost. With the integration of The Ministry of Science's Dasar Teknologi Nuklear Negara (DTNN), it falls short on whether the nuclear power can reach throughout the whole country and to consider the cost of Uranium and other fuels, considering that the fuels are found in only certain countries. This creates a need a small and reliable energy emitter, where people can bring everywhere they go as long as there is Earth to step on.

2. LITERATURE REVIEW

The solvent casting method was a technique that was proven to fabricate thin films. There were various materials that could be used in order to fabricate thin films, which were mostly used polymers like PVDF and composites. Firstly, in making this technique, it started by dissolving the polymer in a volatile solvent to create a homogeneous solution. Then, the solution was poured onto a flat substrate and left to dry according to its required temperature; this allowed the solvent to evaporate. The main factors that affected the film's characteristics were the solvent type, polymer concentration, evaporation rate, and the surrounding environment. In fabricating films, the solvents depend on the polymer solubility and based on film feature requirements. A solvent Dimethyl Formamide was usually used in fabricating films. The features measured were thickness, crystallinity, or surface shape. Advanced techniques involved co-solvents, such as plasticizers, or various drying conditions, which helps improved the film's homogeneity, clarity, and mechanical or electrical properties. (Parida et al., 2023) Previously, solvent casting was used to fulfill industrial needs that demand high-precision films. As an example, in the photographic and optical sectors. then, the applications were applied to electronic gadgets, medicinal films, and biopolymers. The advantages in using solvent casting technique are due to its ability to make films with good flatness, linearity, and isotropic optical characteristics. Many developments have been made, such as extrusion but solvent casting remained essential for applications that need higher quality. This method is still relevant for LCD displays or piezoelectric devices. (Parida et al., 2023)

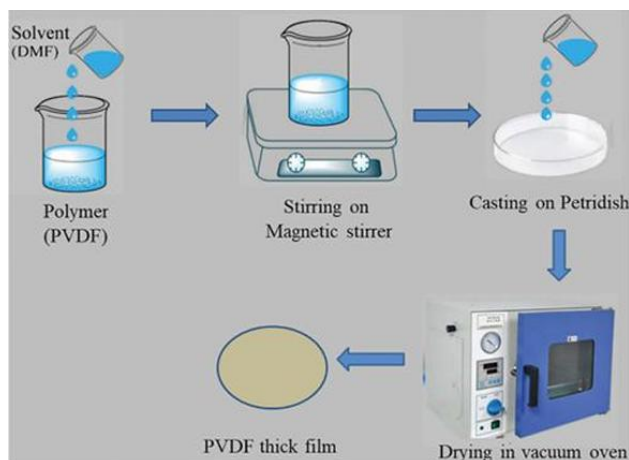


Figure 1: PVDF thick films synthesized by solvent casting method

3. METHODOLOGY

3.1 Testing Pressure Sensor Sample

The capacitance and resistance of the PVDF is tested by using an LCR meter. This systematic approach allowed for a comprehensive understanding of the performance characteristics and behaviours of the pressure sensors under various conditions. Two aluminium strips were used as electrodes to conduct charge made by the pressure sensor.

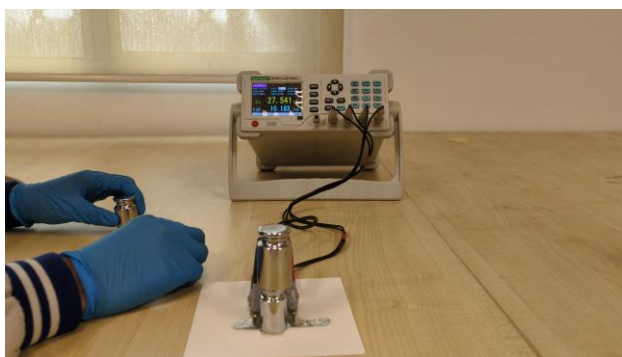


Figure 2: LCR meter with the pressure sensor

3.2 3D Printed Insole

Most of the required equipment such as the 3D printer was already prepared and available at the SMART laboratory, which was administered by the Faculty of Science and Technology (FST). The design of the insole is created by using *Tinkercad*. The software is user friendly and easy to customize for the precise adjustments for ergonomic comfort tailored for the user's comfort. The filament used for the project is Thermoplastic polyurethane due to its flexibility and eco sustainability.

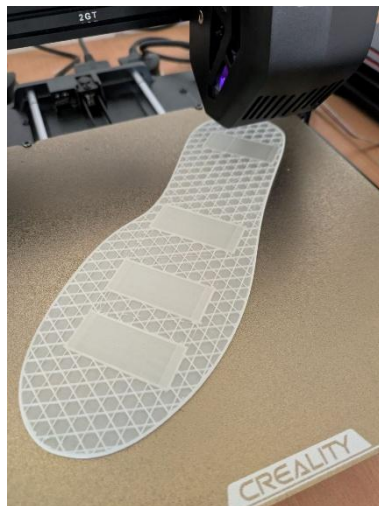


Figure 3: 3D printing of insole

4. RESULTS

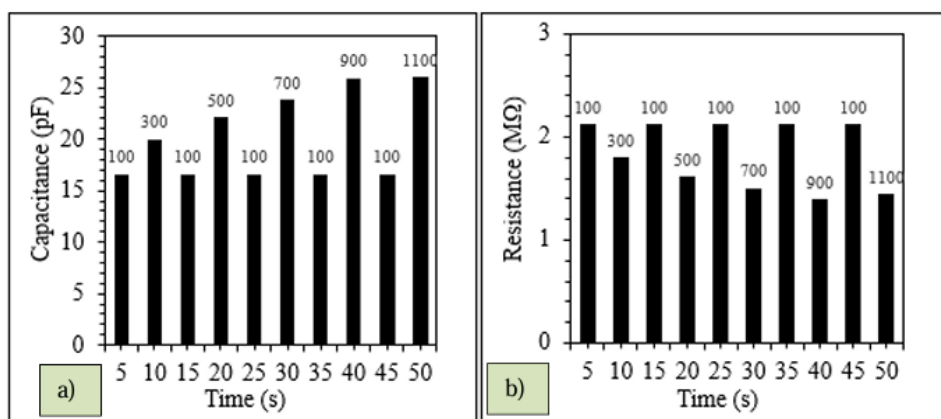


Figure 4: Pure pvdf graph analysis for a) capacitance and b) resistance under varies load

5. CONCLUSION

Ultimately, it is crucial to identify and implement the most efficient and sustainable methods of energy generation to meet growing global demands while minimizing environmental impact. As traditional fossil fuels continue to deplete and contribute to climate change, the transition to renewable energy sources—such as solar, wind, hydro, and bioenergy—becomes not just an option, but a necessity. Investing in innovative technologies, improving energy storage solutions, and adopting smart grid systems will play a pivotal role in ensuring a stable and eco-friendly energy supply for future generations. By prioritizing sustainability now, we can

reduce carbon emissions, enhance energy security, and pave the way for a cleaner, more resilient energy future.

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Chapter 60

Portable Dual-Axis Solar Tracking System with 3D Printed Structure and IoT-Based Real-Time Energy Monitoring

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ABSTRACT

Solar radiation is one of the cleanest sources of renewable energy harvested throughout the world. However, the production of energy from the so-called "large-scale solar farm" is constrained by the availability of sunshine, with "peak sun hours" ranging from approximately four to six hours per day depending on the location of the solar panels. Solar panels installed on the ground or on roofs produce less power during sunrise and sunset than they do during the middle of the day. An automated solar tracking system, on the other hand, can increase energy production since it actively tracks the passage of the sun across the sky. When compared to their static counterparts, single-axis trackers can boost energy production by between 10 to 30%, while dual-axis trackers can enhance production by as much as 40%. This portable solar tracker, which was inspired by sunflowers, not only tracks the sun's movement in response to the presence or absence of light, but it also includes environmental sensors and an Internet-of-Things (IoT) energy monitoring system to provide real-time observation, data collection, and evaluate its overall performance. All these features are operated on this newly introduced simple portable energy monitoring device that comes together with customisable C programming language and python-based application to visualise all the data in real-time. This new development is adaptable for use in portable settings, such as in the military, in Search and Rescue (SAR) operations, and in leisure settings. Additionally, it has applications in the field of space exploration, particularly in satellites, planetary rovers, and the International Space Station (ISS).

Key Words: solar panels, energy, dual-axis trackers, 3D printed structure, Internet-of-Things.

1. INTRODUCTION

The world has been continuously searching for the most environmentally friendly and readily available source of electricity to continue evolving due to the current electricity issue. Renewable energy is energy derived from renewable natural resources like sunlight, wind, tides, water, biomass, and geothermal energy. Solar energy is one of the most promising renewable resources due to its abundance and sustainability. Despite significant advancements in photovoltaic (PV) technology, the efficiency of solar panels remains limited when fixed in position. A dual-axis solar tracking system can enhance energy harvesting by aligning the panel to follow the sun's azimuth and elevation throughout the day. However, conventional trackers are often bulky, expensive, and not suitable for portable applications. This project introduces a portable dual-axis solar tracking system featuring a 3D printed structure, offering lightweight, low-cost fabrication and easy deployment. Additionally, the system is integrated with an IoT-based real-time energy monitoring platform, enabling remote performance tracking via the internet.

2. LITERATURE REVIEW

Electricity is an essential component of nature and one of the most employed forms of energy. Electricity is also known as an energy carrier because it can be converted into other forms of energy, such as mechanical energy and heat. In photovoltaic cells, the efficiency with which sunlight is converted into usable energy varies depending on the type of semiconductor material used and the technology used to make the PV cells. The efficacy of experimental PV cells and PV cells for specific applications, such as satellites in orbit, is close to 50%. Thus, solar energy research on the usage of photothermal (PT) and photovoltaic (PV) has supported the technological development and broad application of energy supply systems based on solar energy in the field of building as an important type of renewable energy (Wang et al., 2023).

Like the behaviour of a sunflower, single-axis trackers also orient themselves towards the sun, aligning their position accordingly. Due to this distinctive motion, they can maintain a perpendicular angle to the sun for prolonged durations, enabling them to absorb significantly higher amounts of energy (often 12-40% more) compared to their counterparts installed for regular usage. But for dual-axis trackers exhibit a high level of diligence and responsibility. These cutting-edge devices can precisely track the movement of the sun in both the east-west and north-south directions, so promising that they are always positioned in such a way as to provide them with direct sunlight. For ThingSpeak IoT database, a remote monitoring and analysis tool for solar trackers, ThingSpeak connects with microcontroller boards such as Arduino and Raspberry Pi. Users may construct customised dashboards with interactive charts and graphs thanks to its dynamic data visualisation capabilities, which offer real-time insights into solar tracker performance parameters.

3. METHODOLOGY

The solar tracker body part is printed using 3D printing methods. First, using Tinkercad an online 3D modelling tool that runs on a web browser, the body parts of the solar tracker were designed after the sizes of the solar panel and servos were measured. Afterwards, the design was stored in a stereolithography (STL) file format and subsequently imported into UltiMaker Cura (Fig. 3.1), the last software application before printing. The Creality Ender-3 3D printer model with PLA 3D printing filament were then used to print the designs (Fig. 3.2). The same process was repeated for constructing four similar mini solar panel grips that were attached to each side of the main solar panel. Assembly and testing came next, following the successfully completed printing of every design.

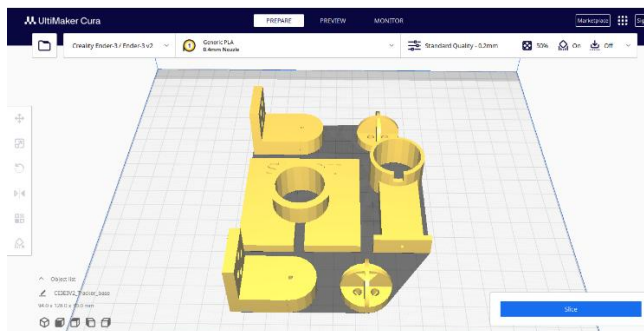


Figure 3.1: Designed solar tracker body parts STL file being transferred into UltiMaker Cura.

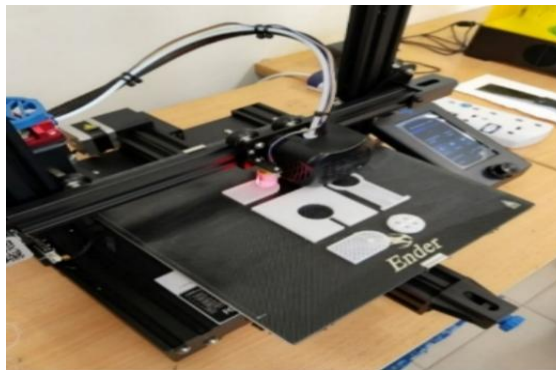


Figure 3.2: Solar tracker body parts printing process

4. RESULT AND DISCUSSION

The performance of the dual-axis solar tracker system is illustrated in Figure 4.1, which shows the system's real-time power output and energy generation. The tracker effectively captured solar energy throughout the day by continuously adjusting its orientation according to the changing position of the sun. This real-time adjustment resulted in visible fluctuations in power output, reflecting the system's responsiveness in maximizing energy collection under different sunlight conditions

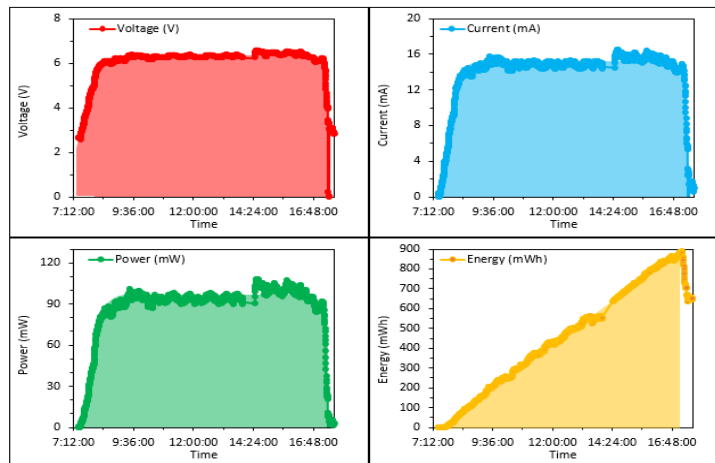


Figure 4.1: Dual axis solar tracker performance

Throughout the testing period, the total energy produced by the system was 892 mWh. Voltage readings varied between 2 to 8 volts, depending on the intensity of solar irradiance at different times of the day. The current output peaked at 16 mA, indicating efficient current flow during periods of high sunlight exposure.

These findings confirm that the dual-axis tracking mechanism significantly enhances solar panel alignment and overall energy production. The system's continuous tracking of the sun's movement in both azimuth and elevation contributes to its high performance and makes it suitable for applications that require reliable and efficient solar energy generation.

The integration of Internet of Things energy monitoring into this study successfully provided data in real time regarding the operation of the solar energy system and the amount of energy it generates via ThingSpeak (Figure 4.2). IoT devices, such as sensors and smart metres, have the capability to gather and communicate data on a variety of factors, such as solar irradiance, panel tilt angles, energy output, and system efficiency (Gupta & Kumar, 2020).

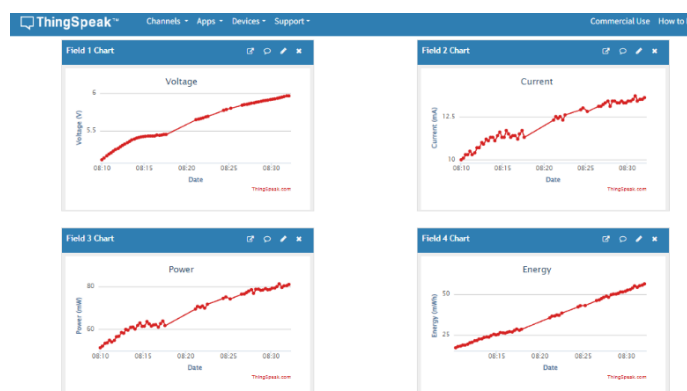


Figure 4.2: Real-Time IoT monitoring of dual axis solar tracker using ThingSpeak

5. CONCLUSION AND RECOMMENDATION

In conclusion, integrating IoT-based energy monitoring with a dual-axis solar tracking system presents a significant advancement in solar energy harvesting. This combination enables real-time remote monitoring and enhances energy output by up to 40% compared to fixed systems. The incorporation of a 3D-printed structure further contributes to the system's portability, cost-effectiveness, and ease of deployment, making it suitable for use in remote or mobile environments. These innovations support the broader adoption of solar energy, contributing to cleaner and more sustainable energy solutions.

For future improvements, research could explore the potential of origami-inspired designs to develop lightweight, foldable, and adaptable solar trackers that offer greater flexibility and ease of deployment. Additionally, the integration of self-cleaning technologies such as hydrophobic coatings or retractable wipers could help minimize dust accumulation on solar panels. Incorporating remote maintenance and diagnostic features may also reduce the need for manual intervention and extend the system's operational lifespan. These developments could further enhance the efficiency, autonomy, and practicality of portable dual-axis solar tracking systems with IoT integration.

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Chapter 61

The Solar Charging Backpack

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ABSTRACT

All undergraduate business students in the Marketing program (BA270) at Universiti Teknologi MARA (UiTM) must undertake the subject *Innovation and New Product Planning (MKT523)*. Students, trekkers, and people in off-grid locations increasingly require renewable energy sources as they rely more on portable electronic gadgets such as smartphones and tablets. Traditional charging methods are ineffective in such areas due to the lack of reliable electricity sources. We recommend the Solar Backpack as a revolutionary, multicomponent solution that offers clean, portable energy while promoting sustainable living practices. The Solar Backpack features thin, foldable solar panels that harvest solar power and convert it into electric energy, which is stored in an onboard rechargeable battery. Built-in USB ports allow users to recharge their electronic devices, while LED indicators display power status during charging. The backpack is made from recycled, durable materials to create a waterproof product suitable for outdoor activities and environments. The Solar Backpack includes all the necessary features to serve as an outstanding choice for individuals who care about the environment and require mobile power and portable storage. The Solar Backpack represents modern green technology advancement through its ability to replace traditional energy sources with renewable power. Both functionally and environmentally beneficial, it is a product well worth investing in to promote sustainable innovation.

Key Words: Solar backpack, renewable energy, portable charging solution, green technology, sustainable innovation

1. INTRODUCTION

The rapid growth of mobile technology has created a higher demand for dependable portable power sources, as these technologies have become essential for everyday activities, including communication, education, navigation, and entertainment. Electronic devices such

as smartphones, tablets, and other digital tools are now indispensable, while the need for continuous power remains a practical issue—especially for mobile individuals who rely on their devices to always remain functional. This power challenge is most critical for people living in rural or remote areas where electricity infrastructure is lacking. In such settings, traditional charging methods are ineffective, creating a gap between device utility and energy availability. The solar backpack addresses this issue by utilizing renewable energy through the integration of solar panels within a backpack. It allows users to store solar power via built-in, foldable, lightweight solar panels, and includes an internal rechargeable battery that enables device charging at any time and in any location. This innovation offers valuable features such as mobility, convenience, and accessibility. The use of eco-friendly technology within a practical design enables the solar backpack to support responsible energy usage and provide effective solutions for individuals who prioritize both functionality and environmental awareness. As a result, it is particularly suitable for students, off-grid users, and those who enjoy outdoor and adventurous activities.

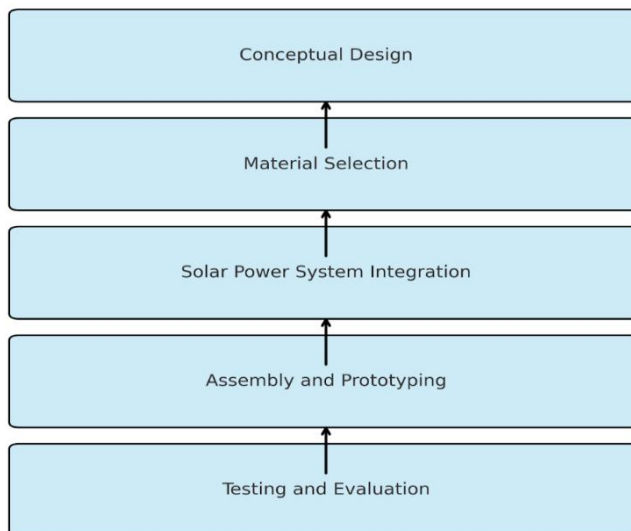
2. LITERATURE REVIEW

Recent advancements in renewable energy technology have significantly improved the design and functionality of solar-powered portable devices. Mohd Faizal et al. (2024) developed a user-oriented solar-powered portable charger that incorporates IoT elements, specifically designed for outdoor and off-grid applications. According to their study, the device emphasizes usability while ensuring sustainable power capabilities that allow it to function independently of traditional energy sources. Verma (2024) explores the evolution of solar technology, detailing the progression from first-generation silicon cells to more advanced multi-junction and perovskite-based technologies. He highlights that scalability and cost-effectiveness are crucial factors for the sustainable global development of solar-powered products. Further contributing to this field, Ramesh and Suresh (2023) examine how consumer perceptions influence the adoption of green technologies. Their research suggests that environmentally friendly materials, paired with transparent marketing strategies, play a vital role in shaping consumer behavior, aligning with the values and expectations of environmentally conscious buyers.

3. METHODOLOGY

3.1 Conceptual Design

The first stage concentrated on recognizing the requirements of intended users like students, hikers, and commuters. A design brief was developed detailing the preferred characteristics: lightweight framework, ergonomic support, ample storage, and built-in solar energy production. Drawings and three-dimensional models were made utilizing CAD applications such as AutoCAD or SolidWorks.



3.2 Material Selection

Sustainable and long-lasting materials were selected. The exterior material utilized is water-repellent, recycled polyester. For the energy system, efficient and adaptable monocrystalline solar panels with outputs ranging from 5W to 10W were chosen due to their light weight and flexibility for use on curved surfaces.

3.3 Integration of Solar Power Systems

A small solar panel system was set up on the upper flap of the backpack, linked to a charge controller and an integrated 10,000mAh lithium-ion battery pack. The charge controller managed current flow and stopped overcharging. USB ports were incorporated for charging devices.

3.4 Assembly and Prototyping

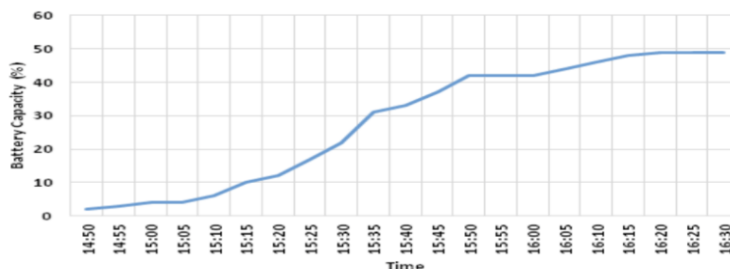
Components were added to the backpack by hand, guaranteeing secure positioning and waterproof wiring. Multiple prototypes were created and improved upon considering their functionality and user input.

3.5 Testing and Evaluation

The ultimate prototype underwent testing in natural sunlight for evaluating solar charging effectiveness, resilience, and user-friendliness. Examinations encompassed:

Charging Time: Recording the time required to completely charge typical gadgets. Example: (mobile phone).

- i. *Energy Output:* Assessing 5-10 voltage/current in varying sunlight conditions with a multimeter.



- ii. *Durability Assessment:* Mimicking everyday usage scenarios such as rainfall, weight pressure, and extended usage.
- iii. *Potential User Feedback:* Assessing 10–20 individuals regarding functionality, comfort, and visual appeal.

4. RESULTS & DISCUSSION

The Solar Charging Backpack was created in response to the current demand for sustainable and portable charging options. Users may charge their electronic gadgets while on vacation thanks to the backpack included power bank 10,000–20,000 mAh and flexible, lightweight solar panels. Its UV-protected, water-resistant fabric guarantees sustainability in a variety of settings. Strong acceptability and pleasure with its capabilities are shown by experimental evaluations and user feedback, especially among target users, including students, tourists, and outdoor lovers. Some of the most significant performance outcomes are:

1. Effective charging capabilities: Able to use solar alone to charge cell phones and other small gadgets.
2. Sustainable power storage: A power bank has enough energy stored to charge multiple devices.
3. User satisfaction: Good feedback because of the design beauty, simple use, and environmental advantages.

The Solar Charging Backpack successfully fulfils the growing need for portable, environmentally friendly charging options. In a world where electronic devices are used completely, this product provides a useful substitute for conventional power sources. Combining solar technology into a useful backpack design offers a creative way to address the common issue of dying batteries during outdoor activities, vacation, or journeys. From an environmental point of view, using renewable solar energy reduces dependency on electricity, which is consistent with worldwide green energy trends.

5. CONCLUSION & RECOMMENDATION

The Solar Charging Backpack is an important development in the introduction of renewable energy technology into everyday products. In without electricity or outdoor environments where conventional power access is not available, it successfully meets the modern need for sustainable, portable charging solutions. The device shows both creativity and environmental responsibility with its ecofriendly materials, simple design, and useful features like flexible solar panels and high-capacity power banks. Response and user testing verify how applicable it is to target audiences, including tourists, students, and outdoor lovers. In addition to satisfying the needs of today busy lives, the Solar Charging Backpack is a multipurpose and environmentally friendly product that encourages increased understanding and use of environmentally friendly innovations in daily life.

- i. *Improve the Capabilities for Charging*
Increase battery capacity and solar panel efficiency to handle more demanding electronic devices and allow quicker charging.
- ii. *Establish Innovative Technology*
For actual time battery and charging status monitoring, include features like integrated indicators or mobile app access.
- iii. *Increase Environmentally Friendly Branding*
To draw in eco aware customers, highlight in your marketing the usage of recycled materials and sustainable production techniques.
- iv. *Improve Market Reach*
To increase awareness and trust, establish partnerships with digital stores, outdoor equipment manufacturers, and educational institutions.

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Chapter 62

Kabel Realiti AR: A Network Cabling Learning Application

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ABSTRACT

Network cabling is a vital component of data transmission systems and forms the backbone of modern infrastructure such as data centers and home networks. However, in many educational institutions, particularly vocational colleges limited access to physical cabling materials makes it difficult for students to gain practical experience. Traditional learning methods like textbooks and static presentations often fail to effectively convey the structure and functions of different cable types. To address this issue, Kabel Realiti AR was developed, an Augmented Reality (AR) learning application designed to support the KSK2033 Network Cabling Preparation module at Malaysian Vocational Colleges. The app enhances learning through interactive 3D AR cable models, brief explanatory notes, and a user-friendly interface with gamified elements to cater to visual and kinaesthetic learners. Developed using Unity and the ADDIE instructional design model, the project also utilized Blender for 3D modeling and Figma for UI/UX design. The AR feature allows students to view and manipulate cable models in real time using smartphones equipped with ARCore-compatible hardware, offering an immersive and engaging educational experience. Beyond classroom use, the app serves as an alternative digital resource for both students and instructors in Computer Systems, Networking, and general IT fields. By offering a scalable, affordable, and interactive solution, Kabel Realiti AR promotes deeper understanding, greater student engagement, and improved knowledge retention. This project highlights the valuable integration of AR technology in technical education and supports the advancement of vocational learning environments.

Key Words: Learning Application, Augmented Reality, Network Cabling, Interactive Learning Tool, ADDIE methodology, Information Technology

1. INTRODUCTION

The Kabel Realiti AR application is developed by the Department of Information and Communication Technology at Kolej Vokasional Kudat. This application includes concise

learning notes and integrates Augmented Reality (AR) technology for educational purposes in line with the KSK2033 Network Cabling Preparation module. This module is a core requirement in the Malaysian Vocational Certificate (SVM) program for the Computer Systems and Networking Technology course offered at Malaysian Vocational Colleges. What makes this application special is its Augmented Reality feature, which allows users to view various types of network cables in semi-virtual 3D form. The application is not only suitable for students enrolled in the Computer Systems and Networking Technology program but is also accessible to anyone interested in learning the basics of industrial network cable types.

2. LITERATURE REVIEW

2.1 Concept and Explanation of AR Technology

Augmented Reality (AR) presents 3D virtual information while remaining connected to the real world, enabling users to interact with virtual objects naturally. Initially used in fighter pilot helmet displays, AR is now widely accessible through smartphones and headsets. It works by merging virtual images with reality via infrared sensors or smartphone cameras. Designed to enhance learning and interaction, AR is valuable for location tracking, markers, and data visualization (Chen et al., 2019).

2.2 AR Technology in The Entertainment and Gamification Industry

Augmented Reality (AR) and Virtual Reality (VR) have revolutionized 2D and 3D gaming by enhancing user interaction with digital environments. AR overlays digital elements onto the real world, while VR creates fully immersive virtual spaces. Companies like Microsoft and Meta have invested in AR development, supporting user-generated applications and services. Major manufacturers like Apple and Google integrate AR into platforms such as Apple Maps and Google Earth (Mealy, 2018). Development tools like ARCore and ARToolkit ensure compatibility with Android and iOS. The gaming industry has embraced AR and VR through devices like Samsung Gear VR, Microsoft HoloLens, PlayStation VR, and Google Cardboard, featuring eye tracking and motion controllers for enhanced interaction. These advancements make AR and VR essential in gaming, creating dynamic visuals that adapt to user movements and perspectives (Mealy, 2018).

2.3 Types of Internet Network Cabling Mediums

Internet network cabling plays a crucial role in data transmission, evolving from traditional copper-based telephone lines to more advanced broadband cables. UTP (Unshielded Twisted Pair) and STP (Shielded Twisted Pair) cables, commonly used in network setups, enhance data quality by reducing interference, though STP is more flexible but less resistant to signal disruption (A. Kateeb et al., 2013). Coaxial cables, known for durability, are widely used in television and older internet systems, but UTP remains the preferred choice for DSL services, utilizing telephone lines for internet access. Fiber optic cables, transmitting data as light signals through glass fibers, offer unmatched speeds ranging from 100 Gbps to 402

Tbps, but their fragility makes them vulnerable to breakage and external damage (A. Kateeb et al., 2013). Each cable type serves distinct purposes in network infrastructure, balancing speed, durability, and accessibility.

3. METHODOLOGY

The ADDIE model Analysis, Design, Development, Implementation and Evaluation is a widely used framework in instructional design. It follows an iterative approach, where feedback from the evaluation phase informs revisions to earlier stages, ensuring continuous improvement. Each phase provides opportunities to refine and enhance the learning process, making it an effective methodology for designing educational tools and programs.

3.1 Analysis Phase

The Analysis phase involved collecting data to identify challenges faced by the target group and determine suitable solutions, using a survey to assess students' and lecturers' existing knowledge of system hardware. Section A gathered demographic details, including age range and institution name, to understand how respondent backgrounds influenced their responses. Section B evaluated application functions regarding readability of the notes, 3d models interactivensess to input and 2D game experience. Section C focused on application design, assessing theme consistency, colour schemes, font readability, notes design and 3D model clarity to ensure a user-friendly experience. The insights from this phase played a crucial role in refining the application for optimal usability and effectiveness.

3.2 Design Phase

This phase involves processes that illustrate relevant information in the development of the application. This includes sketches of the application's functions and working process of developing the app in a flow diagram form. The purpose of this is to facilitate a clearer understanding of the initial structure of the application being developed.

3.3 Development Phase

This phase involves the process of developing the application, starting with the collection of application content such as notes, making 3d models and structuring and implementing coding functions. In addition, the development process uses software such as Unity, Blender and Visual Studio Code along with the programmed code that has been created.

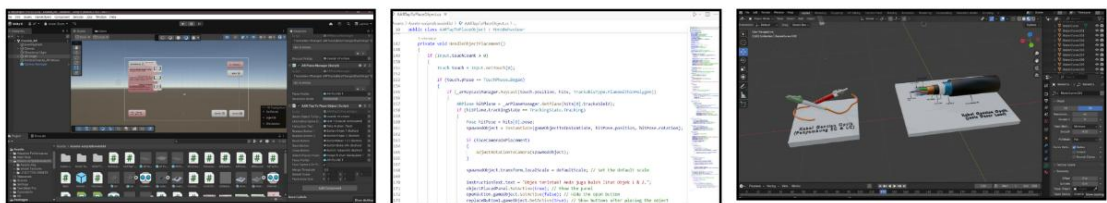


Figure 8: Designing in Unity, Coding structure and 3d modelling

3.4 Implementation Phase & Evaluation Phase

The Implementation Phase follows application development, ensuring proper functionality for end users. Real-world usage and training are conducted based on instructional modules, with staged evaluations to identify minor issues like interface bugs or performance errors. Documentation supports continuous improvement, while feedback from Google Forms and evaluation sheets refines the application. This phase transitions the app from beta to official release on platforms like the Google Play Store and Apple App Store, alongside promotion efforts.

The Evaluation Phase is the final stage, where the completed application undergoes user testing to assess usability and effectiveness. Users interact with the app, providing feedback through surveys to measure functional performance and user experience. Responses are analysed to ensure alignment with project goals, informing future enhancements for improved usability and engagement.

4. RESULTS & DISCUSSION

The project was successfully completed, delivering all planned features and content. A major strength is the 2D cable color-coding game, which users found engaging and easy to understand. The app received positive feedback for its consistent interface, appealing color theme, and responsive 3D model, making it effective for visual learners. However, some weaknesses were noted. The AR feature using Google ARCore is not supported on all Android devices, limiting access. The 2D game's interface design differs from the rest of the app, causing inconsistency in aesthetics. Additionally, the app is not yet available on the Play Store, restricting accessibility. Addressing these issues will enhance usability and expand its reach.

5. CONCLUSION & RECOMMENDATION

The project was completed on time with effective planning and development, receiving positive feedback. The AR-based application is now ready for Malaysian Vocational College students, offering interactive model manipulation to enhance learning. It has potential for expansion to lecturers and the public, especially for teaching network cabling. To improve usability, recommendations include listing ARCore compatibility on the Play Store, refining the 2D game interface, and setting a public release date. Future updates could add quizzes, more mini-games, and clearer AR object manipulation instructions. An iOS release is also planned to broaden accessibility.

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Chapter 63

An AI-Based Mental Health and Loneliness Support Plushie

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ABSTRACT

Mental health is a major public health concern around the world, and it should play a prominent role in the healthcare business. However, the rate of progress in this subject appears to be relatively modest. Recently, AI techniques have gained a lot of attention in other industries, including mental health. Current developments highlight AI's revolutionary potential, with applications including early identification of mental health issues, individualized treatment programs, and AI-powered virtual therapists. SoulSense has the potential to lower barriers to mental health care by offering 24-hour access, lowering costs, and reducing the stigma associated with seeking therapy. AI systems may examine enormous information to identify trends that human clinicians may overlook, resulting in more accurate assessments and tailored treatment strategies. However, the implementation of SoulSense in mental health presents considerable hurdles. Concerning areas like data privacy, ethical use, algorithmic prejudice, and AI's inability to completely duplicate human empathy must be addressed. This research investigates how SoulSense can supplement traditional therapy, the advantages and disadvantages of existing AI mental health technologies, and the ethical concerns required for responsible innovation. By evaluating current breakthroughs and case studies, the study hopes to emphasize the potential for AI to complement, rather than replace, human-centered mental health care, ensuring that technology improves rather than degrades therapeutic outcomes.

Key Words: Artificial Intelligence, Mental Health, Diagnosis, Therapy, Ethical Concerns

1.0 INTRODUCTION

According to a scientific brief published in 2022 by the World Health Organization (WHO), the prevalence of anxiety and depression rose by a staggering 25% worldwide in the first year of the COVID-19 pandemic. The extreme stress brought on by the pandemic's social isolation is a key factor in the rise. Anxiety and depression have also been linked to several stressors, including loneliness, financial concerns, sadness following a loss, fear of infection, and suffering and death for oneself and loved ones. Since many people are unable to receive in-person care, they have turned to online resources for support, indicating the critical need for conveniently accessible and trustworthy digital solutions. Nonetheless, creating and implementing digital solutions continues to be extremely difficult in nations and environments with little resources.

If such an essential need is not met, it is common for individuals to experience feelings of loneliness (Chang et al., 2020). Numerous studies have linked loneliness to a variety of chronic diseases, making it an increasing worldwide issue for adult populations. It is assumed that emotional loneliness refers to the absence of an attachment figure (together with feelings of isolation) and social loneliness as the lack of a social network, the absence of a circle of people that allows an individual to develop a sense of belonging, of company, of being part of a community (Yanguas et al., 2018). Although loneliness is not an officially recognized mental health illness, it is a crucial component that can have a negative impact on mental health and raise the risk of conditions like anxiety and depression.

Loneliness and mental health support needs must evolve in today's fast paced, technologically advanced, continuing and available without putting the user under additional clinical pressure. A clever, emotionally resonant plush device, SoulSense is a cutting-edge mental health and loneliness companion. SoulSense seamlessly integrates Ai-powered insights with empathetic design to give people real time emotional well-being monitoring and deliver psychiatrists safe, useful data for better therapy. SoulSense reimagines how mental health can be supported, not only in therapy sessions but also in the daily life of those who need it most, by turning a soft toy into a scientifically useful yet emotionally accessible tool.

2.0 LITERATURE REVIEW

Over the decade, AI has been used to aid or even replace humans in many professional fields. One of the most promising areas of development for AI is healthcare (Mishra et al. 2021). AI is quickly becoming effective at performing several tasks in the healthcare setting that we used to consider a human prerogative. In particular, AI seems to be better than humans at diagnosing some diseases because it can learn from vast datasets and recognise patterns better than we can (Loh 2018).

AI has proved helpful in diagnosing mental illness, often via means unavailable to human therapists. In particular, AI has been used to help with mental healthcare in three main ways, namely through “personal sensing”, through natural language processing, and through chatbots (D’Alfonso 2020). SoulSense can upgrade mental health practice via better informed, personalized and predictive decisions without replacing the human role. Despite these developments, the ethical implications of employing AI in therapy must not be

neglected. As Mittlestadt et al. (2016) note issues such as data privacy, algorithmic prejudice, and computers' lack of emotional intelligence. To maintain user confidence and safety, SoulSense must be built with strong data protection protocols and transparent algorithms.

Finally, there seems to be at least some potential for AI as a beneficial tool in the provision of mental healthcare. Here, we have been concerned primarily with the possible use of SoulSense AI to solve some long-standing problems in mental healthcare provision. However, in order to have a real-world impact, such systems must address not only the technological and clinical aspects of mental health care, but also the ethical, emotional, and cultural complexities.

3.0 METHODOLOGY

This study employed a quantitative research approach using an online survey to explore young adults' perceptions of mental health challenges and their openness to AI-based emotional support tools, including a concept product called SoulSense. A total of 12 female participants aged between 18 to 34 took part in the survey. Most of them were students aged 18–24, enrolled in programs such as Business, Psychology, Tourism, and Information Technology, while a few were working professionals in fields like Nursing and Administration.

The survey was distributed through informal online channels using a convenience sampling method. It included structured questions on stress frequency, perceived barriers to seeking mental health care, trust in AI tools, and preferred features for emotional support technology. Participants also provided feedback on their comfort level, expectations, and concerns regarding the proposed SoulSense product. All responses were collected via Google Forms and analyzed using descriptive methods to identify patterns and trends relevant to the study's objectives.

4.0 RESULT AND DISCUSSION

4.1 Result

The survey was taken through Google Forms and presented a questionnaire to investigate the possibilities of acceptance and the practicality and consumer interest in the AI-based product of emotional and mental support. A companion. The results were visualized by means of diagrams and tables that reflected not only the survey but the overall research methodology as well.

i. Demographic Profile of Respondents:

A total of 12 responses were collected. The demographic characteristics of the respondents are as follows:

Table 1 Demographic Profile of Respondents

Demographic Categories	Subcategory	Percentage
Gender	Female	100%
Age group	18-24 years	91.7%
	25-34 years	8.3%
Occupation	Student	83.3%
	Work	16.7%

ii. Feedback on SoulSense Concept:

Table 2 Feedback on SoulSense Concept

Question	Response	Percentage
How would you feel about using a plush toy integrated with AI for emotional support?	Very comfortable	8.3%
	Comfortable	16.7%
	Neutral	66.7%
	Uncomfortable	8.3%
Would you prefer a device like SoulSense to be used on a regular basis or just during moments of high stress or anxiety?	Regular basis (daily or weekly check-ins)	41.7%
	Only during high-stress moments	16.7%
	I'm unsure	41.7%
Do you think having a companion app with SoulSense would be beneficial for tracking and improving emotional health?	Yes	25%
	No	8.3%
	Maybe	66.7%
What kind of features would you expect from a plush toy that provides emotional support?	Real-time emotional analysis	66.7%
	Sensor-based tracking (e.g., heart rate and grip pressure)	50%
	Customizable responses	41.7%
	Based on my emotions	
	Connection to a mobile app	50%
	To track mood and journal	
	Privacy and security data	50%

4.2 Discussion

The results reflect a growing awareness of mental health among young adults, though barriers like cost, access, and social stigma still prevent many from seeking help. Interestingly, while most respondents don't currently trust AI for emotional support, there's a willingness to try such tools if provided with more information and assurances of privacy. The strong interest in features like mood tracking and connection to professionals suggests that users don't see AI

as a full replacement but rather a complementary support system. The feedback on SoulSense implies that users value emotional comfort but are also highly sensitive to privacy and personalization. These findings validate the importance of designing mental health tech with a user-first approach, focusing on trust-building, real-time responsiveness, and secure data handling.

5.0 CONCLUSION AND RECOMMENDATION

In conclusion, one of the major indicators of social well-being is loneliness. Numerous physical and mental health conditions can result from loneliness. Loneliness can have a negative impact on one's physical and emotional well-being if neglected. Addressing the growing issue of adult loneliness may be greatly assisted by a human-centered approach to AI in mental health and loneliness. SoulSense lowers the psychological barriers to self-expression and involvement by integrating AI-driven journaling and monitoring tools into a soft approachable plush toy companion. This is especially beneficial for kids, teenagers and people who are reluctant to utilize standard digital tools. Early implementation and preliminary user feedback points to a great potential for enhancing emotional self-awareness and persistence to mental health and loneliness routines. While technology alone cannot replace the richness of human connection, it can provide meaningful support, companionship, and pathways toward healing when developed (Sullivan et al., 2023). By grounding AI in the lived experiences of users and aligning design with core psychological and social values, one can move beyond reactive solutions towards proactive, empowering interventions (Sullivan et al., 2023).

The ethical regulation of digital mental health technologies, long term emotional results, and hybrid models of care should all be explored more thoroughly in future studies. To evaluate the effectiveness of AI based therapies and the combination of AI based and human based interventions, more study needs to be conducted. Each recommendation needs to be supported by relevant needs and literature review to guide future research and validation. The first recommendation is to adapt SoulSense to accommodate a range of age groups and demographics, such as youngsters, and people with neurological disorders, and culturally varied communities, making sure that the language and design reflect inclusive values. To identify specific requirements, cultural barriers and accessibility enhancements, research needs are determined by conducting usability studies, testing and participatory design sessions with underrepresented user groups. Next recommendations are to improve treatment sessions and remote care coordination by developing a safe, user-friendly clinician dashboard with visual data summaries, personalized alarms, and mood tracking trends. Working with legal and ethical professionals to audit the system's privacy is necessary for this recommendation's research, particularly when it comes to use by minors or in a clinical setting.

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Chapter 64

HIPPOWONDERS

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ABSTRACT

HIPPOWONDERS is an educational innovation designed to enhance story writing skills among upper primary students (Years 4 to 6). The goal is to make creative writing more engaging, structured, and accessible through the integration of physical and digital learning tools. The innovation features three key components: flashcards, a dedicated website, and a multi-level quiz. The flashcards, which focus on idioms and expressions, are used during face-to-face classroom sessions to enrich vocabulary and foster expressive language. The website acts as a central hub, containing story writing notes, links to a three-level online quiz, a Padlet space for students to upload their creative works, a Google Form for user feedback, and printable worksheet and flashcard templates for students who wish to use them independently. By combining traditional learning tools with interactive digital platforms, HIPPOWONDERS supports students in developing coherent story structures and imaginative content. This innovation not only promotes independent learning but also encourages peer sharing and reflection, ultimately nurturing confident and creative young writers.

Key Words: Engagement, Writing, Student, Technology, Flashcards

1. INTRODUCTION

Creative writing is essential in language education, nurturing imagination, critical thinking, and linguistic proficiency (Bingol, 2023). However, upper primary students often face challenges such as limited vocabulary, poor understanding of story structure, and low engagement levels. These obstacles hinder their ability to write effectively and express ideas fluently, impacting their confidence and creativity (Cosgun & Atay, 2021).

To address these issues, the HIPPOWONDERS innovation was developed to enhance story writing through innovative tools. Combining physical and digital resources, the innovation includes idiom flashcards for vocabulary building, an educational website with

writing guides and templates, and an online quiz system for structured learning. By promoting both teacher

led and independent learning, HIPPOWONDERS supports creative thinking, engages students, and fosters a lasting love for storytelling.

2. LITERATURE REVIEW

Creative writing remains a fundamental element of language education as it plays a crucial role in enhancing linguistic proficiency, critical thinking, and creative expression (Cosgun & Atay, 2021). It allows students to explore and articulate ideas in diverse ways, fostering both personal and intellectual growth. However, despite its significance, many students encounter obstacles in the creative writing process, including limited vocabulary, inadequate structural understanding, and a lack of sustained engagement (Bingol, 2023). These challenges can hinder students' ability to effectively express their ideas and achieve coherence in their writing. Building on these advancements, the HIPPOWONDERS innovation exemplifies an integrated approach to addressing the challenges in creative writing. By incorporating idiom flashcards, an educational website, and an online quiz system, HIPPOWONDERS aims to enrich students' vocabulary, improve structural understanding, and increase engagement in the writing process. This multi-faceted approach not only addresses the limitations faced by students but also makes creative writing an enjoyable and enriching experience. The combination of traditional and digital tools in this innovation underscores the importance of a balanced approach to teaching creative writing.

In conclusion, creative writing serves as a cornerstone of language education, yet it is not without its challenges. The HIPPOWONDERS innovation further reinforces these efforts by offering a comprehensive framework to support vocabulary development, structural coherence, and engagement in writing. These advancements demonstrate the evolving nature of language education, where creativity and critical thinking are continually nurtured to meet the demands of the modern educational landscape.

3. METHODOLOGY

This study utilized a mixed-method approach, integrating quantitative and qualitative techniques to address challenges in creative writing. The HIPPOWONDERS innovation comprised idiom flashcards for vocabulary development educational website offering resources like writing guides and interactive platforms, and an online quiz system with varying difficulty levels to enhance story structure comprehension.

The innovation was implemented in primary schools, focusing on students in Years 4 to 6. Teachers were trained to integrate the tools into classroom settings, while students independently engaged with the digital resources (Vygotsky, 1978). Quantitative data were analyzed statistically, while qualitative data were thematically coded. Ethical considerations included informed consent and data confidentiality, adhering to established research guidelines.

4. RESULTS & DISCUSSION

The HIPPOWONDERS innovation has proven effective in enhancing vocabulary usage, particularly idiomatic expressions and descriptive language, in writing. Table 1 shows that 20 pre-service teachers had a positive view of HIPPOWONDERS, using a 5-point scale (1 = lowest, 5 = highest) to rate student performance and the tool's effectiveness.

Before using HIPPOWONDERS, 60% of respondents rated students' writing at level 2 and 40% at level 3, indicating generally low to moderate proficiency. After implementation, 65% rated student performance at level 5 and 35% at level 4, reflecting a clear improvement in storytelling skills.

In terms of helpfulness, 80% rated HIPPOWONDERS a 5, and 15% a 4. Overall satisfaction was also high, with 80% selecting level 5 and 20% level 4. The tool's structured flashcards, online resources, and interactive quizzes effectively support creative writing development.

Respondent feedback highlighted improved creativity, critical thinking, grammar, and vocabulary. One respondent called it "an excellent teaching aid," while another praised its role in the learning process. In conclusion, HIPPOWONDERS fosters better writing skills, learner autonomy, and a collaborative digital space for young writers.

Table 1 Pre-service Teachers' Responses on the Feedback of HIPPOWONDERS

RESPONSE	1		2		3		4		5	
ITEMS	N	%	N	%	N	%	N	%	N	%
Rate students' performance before using HIPPOWONDERS	2	0.0	12	60.0	6	40.0	0	0.0	0	0.0
Rate students' performance after using HIPPOWONDERS	0	0.0	0	0.0	0	0.0	7	35.0	13	65.0
How helpful is HIPPOWONDERS	0	0.0	0	0.0	1	5.0	3	15.0	16	80.0
Overall rate	0	0.0	0	0.0	0	0.0	4	20.0	16	80.0

5. DESIGN DESCRIPTION

The HIPPOWONDERS innovation comprises three core components designed to create a comprehensive and engaging learning experience: a dedicated website, idiom flashcards, and a multi-level quiz system. Together, these tools address key challenges in creative writing, such as limited vocabulary, structural difficulties, and low engagement, while promoting both teacher-led and independent learning. The website (Figure 1) acts as the central hub for the innovation, offering a range of resources to support writing development. It features detailed writing guides, printable templates, and interactive elements like quizzes and a Padlet board. By combining accessibility with interactivity, the website encourages students to explore and refine their writing skills independently.

Idiom flashcards play a vital role in expanding students' vocabulary and introducing them to

expressive language forms, such as idiomatic expressions. These flashcards are used during face-to-face classroom sessions to foster linguistic creativity and enrich narrative content. The multi-level quiz system, enhanced with gamified features, offers structured challenges across three difficulty levels. Each quiz is designed to reinforce students' understanding of story structure, motivating them to apply their knowledge in creative ways. Additionally, feedback forms (Figure 2) are integrated into the system to evaluate its effectiveness and gather insights from pre-service teachers. This feedback loop ensures that HIPPOWONDERS remains adaptable and impactful, aligning with the needs of students and educators alike. Together, HIPPOWONDERS exemplifies the potential of educational innovations to make learning engaging, accessible, and transformative for young writers.



Figure 1: Main page of HIPPOWONDERS

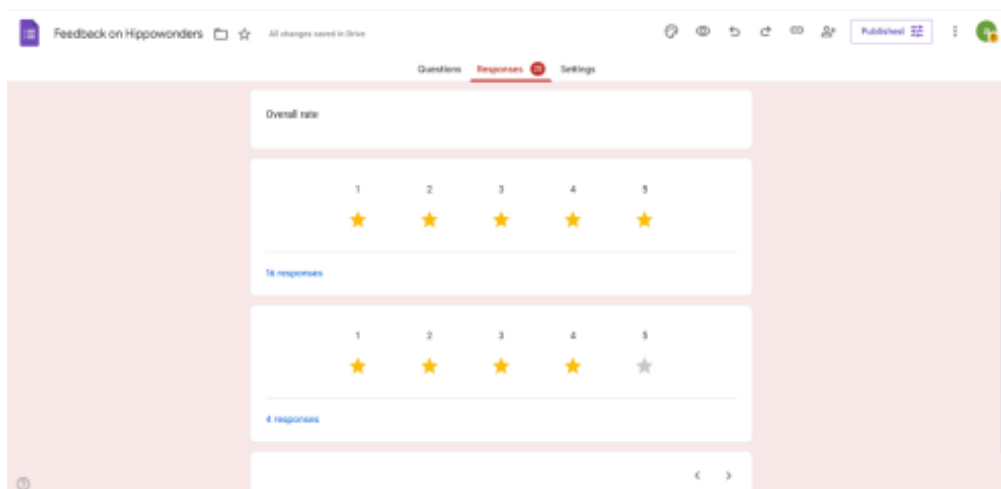


Figure 2: The responses and feedback

6. CONCLUSION & RECOMMENDATION

The HIPPOWONDERS innovation has proven to be highly effective in addressing the challenges faced by upper primary students in creative writing, particularly limited vocabulary, poor structural understanding, and low engagement. By integrating three core components: idiom flashcards, an educational website, and an online quiz system, this initiative successfully combines physical and digital tools to enhance learning outcomes. Students showed noticeable improvements in vocabulary usage, narrative organization, and creativity while the interactive nature of the resources kept them engaged and motivated. To further amplify the impact of HIPPOWONDERS expanding its implementation to more schools and age groups is recommended. This will allow a greater number of students from diverse educational backgrounds to benefit from the innovation.

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Chapter 65

Boosting Performance through Quick Align Solutions

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ABSTRACT

Dental simulation training has become a fundamental part of undergraduate dental education. Traditional mounting systems, particularly those using Plaster of Paris (POP), have long been the gold standard. However, POP presents various limitations, such as brittleness, poor retention, difficulty in alignment, time-consuming procedures, and lack of reusability. This paper introduces Quick Align, an innovative simulation model that uses epoxy resin with a magnetic metal attachment to overcome these challenges. This model allows efficient mounting and realignment of extracted human teeth while ensuring strong retention in the phantom head simulator. It also incorporates features for radiograph-taking and improved compatibility with operative protocols like rubber dam application. Survey results revealed significant improvements in stability, efficiency, and user satisfaction, making Quick Align a sustainable, cost-effective, and educationally valuable solution.

Keywords: dental simulation training, preclinical dentistry, epoxy resin, phantom head, reusable model

1. INTRODUCTION

Operative dentistry is a branch within dentistry concentrated on the functional and aesthetic rehabilitation of hard tissues. It is also recognised as the cornerstone of dentistry. A fundamental aspect of the undergraduate curriculum in Operative Dentistry and Endodontics is preclinical laboratory or simulation training, which is crucial for developing clinical skills.

This includes the ability to identify carious lesions prior to removal, comprehend the significance of cavity preparation according to the selected restorative material, and restore the tooth to its functional state. In dentistry, the irreversible nature of most operating procedures necessitates that students possess the competencies required for safe execution of patient treatment and care (Perry et al,2015). Simulation enables trainees to practise procedures with pertinent skills and assessed competence without jeopardising an actual patient. Consequently, most psychomotor abilities are acquired through simulation prior to students engaging in direct patient care (Gottlieb et al,2013).

The simulation training has progressed from tabletop simulators utilising typodonts, plastic, or extracted human teeth in a phantom head to contemporary advancements in virtual reality technologies, haptics, and robotics. Nonetheless, dental simulation offers a more authentic clinical educational setting. The phantom head simulator has served as the primary simulation apparatus for preclinical training since its inception in 1894 (Perry et al,2015). The phantom head is attached to a dental operating unit with a torso, enabling positional adjustments for students to work in a sitting and ergonomically suitable manner, akin to a clinical environment. It facilitates the proficient manipulation of both the dental mirror and handpiece, wherein the foundational principles must be mastered prior to advancing to more intricate skills. Contemporary phantom heads feature a water spray mechanism, and genuine teeth may be affixed. The utilisation of "resin-based" or synthetic teeth became increasingly prevalent in preclinical dental education during the 20th century. Nonetheless, replicating real teeth with synthetic alternatives would pose a significant difficulty. The predominant critique was the erroneous resin hardness relative to dentine, leading to modified tactility, which resulted in the lack of a 'drop' into pulp chambers during access cavity preparation, difficulties in locating canal orifices, and complications in root canal instrumentation. The benefits of utilising excised real teeth, encompassing their inherent tissue hardness, shape, colour, texture, and radiodensity, provide them the optimal material for acquiring the fine motor skills essential in restorative dentistry (Decurcio et al,2019). The phantom head simulator was favoured, since students taught on the bench top encountered challenges in transferring abilities to the phantom head, although the reverse was not true (Clancy et al, 2002). In addition to operational dentistry and endodontics, phantom heads are utilised for instructing prosthodontics, periodontics, and paediatric dentistry.

Therefore, preclinical simulation provides a crucial bridge between theory and clinical practice in dental education. It allows dental students to develop essential motor skills, improve hand-eye coordination, and build confidence before treating real patients. The current standard—using POP for mounting extracted teeth (Figure 1)—presents multiple drawbacks: it's fragile, often misaligned, mouldy (Figure 2) and time-consuming to work with. In response to these issues, the Quick Align simulation model was developed to streamline training, enhance model durability, and reduce costs and time wastage.

2. LITERATURE REVIEW

Simulation-based learning has shown a significant positive impact on students' readiness and clinical performance. According to Perry et al. (2015), hands-on practice enhances students' dexterity and judgement. However, Decurcio et al. (2019) emphasize that artificial teeth fail to

replicate the tactile feedback provided by extracted teeth. Gottlieb et al. (2013) note that realistic materials are essential in preclinical endodontic training. Furthermore, Clancy et al. (2002) demonstrated that students trained in simulation environments perform better than those trained in conventional labs. Still, many of these benefits are lost when using outdated POP models, highlighting the need for a reliable, adaptable, and modern system like Quick Align.

Simulation-based education has become integral to dental training, providing students with a controlled environment to develop essential clinical skills before patient interaction. Perry, Bridges, and Burrow (2015) highlighted that simulation enhances psychomotor abilities and decision-making, leading to improved clinical performance. The evolution from traditional models to advanced simulation technologies reflects the ongoing efforts to optimise dental education.

Despite the advent of virtual reality (VR) and haptic technologies, physical phantom head models remain a cornerstone in preclinical dental education. Gottlieb et al. (2013) emphasised that these models offer tactile feedback crucial for procedures like cavity preparation and endodontic access. The realism provided by physical models aids in bridging the gap between theoretical knowledge and clinical application.

Traditional mounting methods, such as using Plaster of Paris (POP), present several challenges, including fragility, susceptibility to mould, and time-consuming preparation. Clancy et al. (2002) noted that these limitations could hinder the learning process and reduce the efficiency of simulation exercises. The need for more durable and user-friendly alternatives has become increasingly apparent.

Innovations in simulation materials and design aim to address these challenges. The development of models like Quick Align, utilising epoxy resin and magnetic attachments, offers improved stability and reusability. Such advancements align with the goals of enhancing educational outcomes while promoting sustainability and cost-effectiveness in dental training programmes. Thune et al (2025) highly recommended the advantages of using extracted teeth in learning dental anatomy and offers better educational results.

3. METHODOLOGY

The Quick Align model was produced from epoxy resin, offering enhanced strength and water resistance compared to POP. A hollow, arch-shaped groove (Figure 3) was integrated for mounting extracted teeth, with optional colours added for identification. Undercuts or grooves were added to the design to retain the mounting compound securely.

The key components include i) Thermoplastic compound: easily mouldable with warm water, allowing quick repositioning of teeth (Figure 4). ii) Radiograph sensor slot: integrated to allow intraoral radiographs to be taken without removing teeth (Figure 5), and iii) Magnetised base: replacing the brittle POP base with a secure metal attachment that holds firmly in the phantom jaw (Figure 6), facilitating stability during procedures like rubber dam placement. Students have the customisable options of full-arch or quadrant-based gutters for varied training needs.

4. RESULT & DISCUSSION

Pre- and post-evaluation among preclinical students was distributed. Based on the result, highly positive feedback was received. 88% of the users found the alignment process much easier than POP models. While 100% agreed the Quick Align model was more stable in the phantom head. 63% said it saved significant preparation time. More than 2/3 of the participants (75%) indicated the model was user-friendly in tooth mounting.

The model's reusability makes it cost-effective and environmentally sustainable. Unlike traditional POP models, which are disposed of after use or become mouldy over time, Quick Align can be cleaned, reused, and passed down to future cohorts. This significantly reduces material waste and long-term operational costs. The integrated radiograph slot is especially beneficial for endodontic training and minimises procedural interruptions.

5. RECOMMENDATION

The Quick Align simulation model addresses the inefficiencies of conventional mounting systems in dental education. By improving stability, simplifying alignment, and supporting radiographic procedures, it enhances both student learning and institutional resource management. Its sustainability and adaptability make it a highly promising innovation. We recommend its adoption in all dental faculties, along with future improvements such as smart feedback integration or haptic-enabled learning systems.



Figure 16: Traditional POP foundation



Figure 2: Mouldy foundation



Figure 3: Quick Align dental simulation model



Figure 4: Compound material is utilised to secure the extracted tooth in position.



Figure 5: Retention-enhancing features, such as undercuts or grooves, can be incorporated into the hollow segment to augment retention. A radiographic sensor slot has been incorporated in the centre of the model to facilitate radiograph acquisition for endodontic procedures.



Figure 6: Metal attached on the epoxy substrate to substitute the non-retentive plastic fastener

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Chapter 66

Emoji Story Quest

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ABSTRACT

In the Malaysian primary school context, enhancing English language learning continues to be a key priority, particularly in fostering vocabulary development, creativity, and student engagement. Conventional classroom strategies often fall short in meeting the needs of digital-native learners, who benefit more from interactive and visually rich experiences. To bridge this gap, Emoji Story Quest was developed as a gamified and collaborative storytelling tool that supports language acquisition through creative expression and digital literacy. This innovation integrates two core components: Moji Moji, an emoji-based guessing game, and the Story Wheel, which provides vocabulary prompts to guide students in building original narratives. By combining vocabulary learning with visual decoding and group-based storytelling tasks, the platform nurtures critical thinking, social interaction, and imaginative language use. It differentiates itself through its emphasis on student agency and engagement, encouraging learners to construct meaning in context and express themselves with confidence. Emoji Story Quest also aligns with the goals of inclusive education by catering to various learning styles and proficiency levels. Its flexible design makes it suitable for both physical and digital classroom settings, with strong potential for integration into wider educational initiatives. Overall, this innovation represents a creative, student-centered approach to English language learning—supporting 21st-century skills and enriching the language learning experience in fun, meaningful ways.

Key Words: Vocabulary, Emoji, Storytelling, Gamification, Digital Literacy

1.0 INTRODUCTION

Language learning is a complex process that requires both cognitive and creative engagement. In many traditional classroom settings, vocabulary topics often lack excitement, resulting in reduced students' motivation and retention. With the rapid advancement of digital tools and increased student exposure to visual communication, there is a need for innovative educational approaches that combine technology, creativity, and interactivity.

Emoji Story Quest was developed to solve this issue. This project aims to transform the conventional methods of vocabulary teaching and storytelling instruction through an engaging, student-driven game. By combining elements of gamification and visual literacy, the innovation offers a new way for students to encourage themselves to explore language meaningfully and collaboratively. The game is particularly effective for upper primary students and can be used in both face-to-face and remote learning environments.

2.0 LITERATURE REVIEW

From Chon et al. (n.d.) research, gamification in education is defined by integrating game-based mechanics and dynamics to create engaging and immersive learning environments. The integration of digital tools and play-based activities in the classrooms encourages productive learning and fosters 21st-century skills' requirements such as creativity, collaboration, and critical thinking.

One of the most commonly used gamified learning platforms is Kahoot!, has been used worldwide to boost student engagement through competitive quizzes and instant feedback (Wang, 2015). Similarly, Quizlet also offers the same methods where it focuses more on students' vocabulary development and understanding. However, while these tools are effective for supplying knowledge, they often lack opportunities for deeper language use and creative ways of reaching the objective.

On the other hand, storytelling is a more effective method of teaching languages than traditional teaching materials like textbooks (Ghafar, n.d.). The storytelling approach could help the students to improve their vocabulary and grammar while enhancing comprehension, memory retention, and emotional intelligence. When students are encouraged to co-create narratives, they become active participants in their own learning improvement journey, constructing meaning in context and improving their confidence in communication. Additionally, Emoji, as a visual medium in language, have gained popularity as communication tools in digital literacy contexts. Mudure-Iacob (n.d.) research stated that emojis in language learning is applied to storytelling as a mechanism of developing a multiliterate discourse.

3.0 METHODOLOGY

The "Emoji Story Quest" is an interactive storytelling game which was developed through a collaborative and coordinated design process. This innovation is specifically designed for year 6 primary school students. The methodology of this project is aimed at creating an engaging and informative game that combines emoji-based guessing, vocabulary building and story creation. This website was shared with 15 primary students in the state of Pahang. A Google Form was administered to these students to gather data regarding their overall experience with this game. The development process of this Emoji Story Quest game involved a few essential stages, such as spinning the vocabulary wheel.

Firstly, the initial stage required brainstorming ideas and identifying the key components of the game. These include the incorporation of emoji puzzles, also known as 'Moji Moji', vocabulary wheels (adjective and verb), and cooperative story creation.

The next stage was focused on the specific mechanics of the game. Virtual wheels were designed to produce vocabulary cues, which include the categories for adjectives and verbs. Emoji sequences were created to represent words or story elements, which require players to decode them. The game was then structured to encourage students to apply creative thinking skills to produce a collaborative story writing, using the vocabulary cues and emoji puzzles as inspiration.

Multiple emoji combinations and story scenarios were created to guide and illustrate the game's potential. Therefore, this iterative process ensured that the methodology of this project utilised a user-friendly approach while prioritising the creation of a fun and impactful learning experience for students of all backgrounds. Ethical concentration was also considered during the innovation process

4.0 RESULTS & DISCUSSION

The participants answered the Google Form within two weeks. The results are as below. All 15 participants (100%) who responded to the survey indicated they enjoyed playing "Emoji Story Quest". (refer to figure 4.1)



Figure 4.1: Respondents enjoyed playing Emoji Story Quest

The most popular aspect of "Emoji Story Quest" was "All of the above" (40%). Many participants (33.3%) especially enjoyed "Spinning the vocabulary wheel." Smaller groups preferred "Writing stories in groups" (13.3%), "Solving emoji puzzles" (6.7%), or the "Story challenges" (6.7%). (refer to figure 4.2)

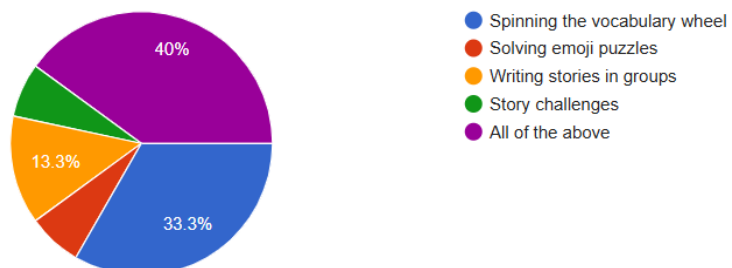


Figure 4.2: Part of the game that respondents enjoyed the most

Most participants (80%) felt the game helped them greatly in using adjectives and verbs, while 20% said it helped a little. (refer to figure 4.3)

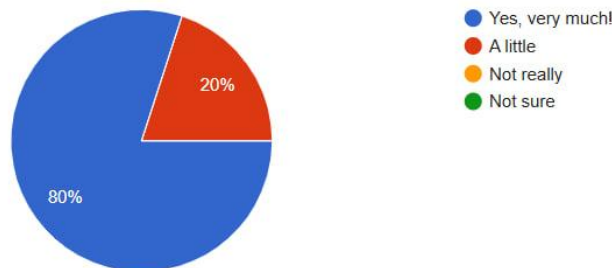


Figure 4.3: Understanding of the respondents on the usage of adjectives and verbs in a sentence or story

Most participants (93.3%) would recommend "Emoji Story Quest," while 6.7% said "Maybe." (refer to figure 4.4)

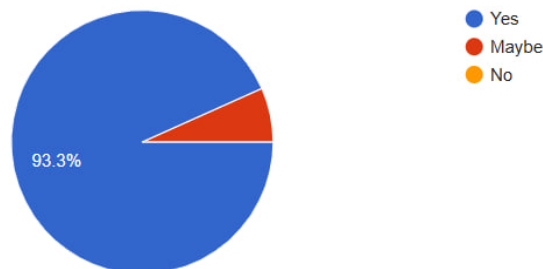


Figure 4.4: Participants' willingness to recommend Emoji Story Quest

5.0 CONCLUSION AND RECOMMENDATIONS

The Emoji Story Quest is an innovative and functional approach to enhance users' vocabulary and writing skills effectively by combining emojis, vocabulary wheels, and storytelling. This project aims to boost students' confidence levels and digital literacy in students. There are also a few suggestions in this project to maintain the effectiveness of the project development. First of all, it is highly recommended to conduct empirical studies with students of all categories. This includes a comparison of learning outcomes between students who approach this game and other traditional methods. Moreover, this game can be enhanced with more features, such as a wider variety of vocabulary wheels and more options for different story genres. This could broaden students' perspective on vocabulary usage for their writing skills. Therefore, the Emoji Story Quest presents a promising avenue for engaging students and fostering essential language skills. By implementing the recommendations and suggestions, this innovation has the potential to significantly impact vocabulary learning, writing proficiency, and digital literacy among young learners.

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Chapter 67

QuizWhiz: A Grammar-Based Board Game for Interactive English Learning

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ABSTRACT

QuizWhiz is a fun and educational grammar board game that helps learners improve their English in an engaging way. Based on the QuizWhiz framework, it focuses on building grammar, vocabulary, and sentence-writing skills through interactive play. Instead of traditional worksheets or lectures, QuizWhiz encourages active learning through tasks, questions, and challenges. The game covers key topics like parts of speech (nouns, verbs, adjectives), sentence types, tenses, conjunctions, punctuation, and vocabulary at three levels (easy, medium, hard). As players move around the board, they answer questions, collect tokens, and build “houses” to show their progress, making learning rewarding and fun. Teachers can use it in class, group work, or even for quick reviews or assessments. It saves prep time and can be adjusted for different levels. QuizWhiz also supports writing skills by linking grammar to real writing tasks, especially for essays. With its colorful design and wide content range, QuizWhiz has strong potential as a digital app with features like progress tracking, voice input, and multiplayer play. Overall, QuizWhiz makes grammar learning fun, effective, and student-friendly; for classrooms and beyond.

Keywords: Gamified learning, grammar, academic writing, English proficiency, vocabulary

1.0 INTRODUCTION

Traditional grammar instruction often relies on memorisation, drills, and isolated exercises, which can disengage learners and limit real-world application. While such methods may support short-term recall, they often fail to sustain interest or deepen understanding, particularly among younger or less motivated students. In response, educators are turning to learner-centred approaches that emphasise interactivity and meaningful learning experiences.

QuizWhiz is a game-based solution that makes grammar and writing instruction more engaging and effective. It transforms learning into an active, hands-on experience through colourful visuals, tiered challenges, and collaborative gameplay. The game aims to help learners master grammar, improve academic writing, build vocabulary at varying difficulty levels, and support both individual and group learning. By integrating essential language skills into one dynamic format, QuizWhiz offers a modern, inclusive approach to English grammar education.

2.0 LITERATURE REVIEW

Game-Based Learning (GBL) is transforming language education by offering an engaging alternative to traditional methods, enhancing learner motivation and retention (Halim et al., 2020; Filament Games, 2023). Game mechanics encourage active participation and collaboration, which are key for language acquisition (EJ Social, 2022). GBL is especially effective in grammar instruction, providing contextualized learning through real-life scenarios, rather than isolated rules (Alice in Methodologyland, 2019; Huang & Soman, 2020).

Platforms like Quizizz have shown positive effects on grammar learning, with ESL learners demonstrating improved skills due to increased motivation and participation (Pham, 2023; Alghamdi, 2024).

QuizWhiz, a board game combining grammar, vocabulary, and writing, reinforces these findings. Its colour-coded zones, task variety, and difficulty levels support inclusive learning, suitable for both solo and group play. Integrating tools like QuizWhiz into grammar teaching enhances motivation, enjoyment, and language outcomes (Aratea & Pasubillo, 2024; Alghamdi, 2024).

3.0 METHODOLOGY

3.1 Design Description

QuizWhiz is a circular, colour-coded board game designed to be both visually engaging and educational. The board is divided into zones, each representing a specific grammar or writing topic, easily identified by distinct colours. Players roll a die to move around the board and land on tiles featuring grammar questions, vocabulary tasks, or short writing prompts. These interactive activities reinforce grammar and vocabulary in context, supporting long-term retention.

The game's content is comprehensive, covering core grammar topics like nouns, verbs, adjectives, adverbs, pronouns, prepositions, conjunctions, tenses, and articles. It also includes comparative and superlative forms, sentence structure (simple, compound, complex), and writing tools such as punctuation, suffixes, and connectors. Vocabulary tasks are tiered across three difficulty levels like easy, medium, and hard, to support progressive learning.

3.2 Game Mechanics

QuizWhiz blends learning with progression and achievement. Players earn tokens for correct answers, which track progress and can be exchanged to "build a house" on the board, symbolizing mastery of topics like "Grammar Grove" or "Vocabulary Villa." This reward system motivates learners and provides visible, goal-oriented outcomes.

The board features special tiles, such as hint (💡) for clues, second chance (🎲) for an extra roll, and rest (🛏️) for a gameplay break. These elements create an engaging, dynamic experience that reinforces learning. QuizWhiz can be used individually, in small groups, or in whole-class activities, and can be adapted into a digital version with features like voice input, multiplayer, and real-time progress tracking.

4.0 RESULTS & DISCUSSION

4.1 Visual Engagement and Learning Impact

QuizWhiz stands out with its vibrant design that enhances learner engagement and memory recall. The color-coded game board separates linguistic categories (e.g., grammar, vocabulary, sentence types) for easy topic recognition. Icons on special tiles like hints and bonus rolls increase clarity and accessibility, especially for visual learners. Tokens and "house building" serve as rewards and progress markers, boosting motivation. The design promotes repeated exposure to grammar topics, reinforcing knowledge through spaced repetition.



Figure 1: QuizWhiz Game Board Layout – A full view of the circular game board showing category zones, bonus icons, and directional flow.



Figure 2: Token Collection Mechanics – Illustrates how players gather and exchange tokens to construct themed houses, symbolizing mastery.



Figure 3: Category-Based Grammar Tiles – Displays color-coded tiles for each grammar topic (e.g., verbs, adjectives, sentence types), enabling quick topic recognition.



Figure 4: Special Squares (Hint, Gift, Challenge) – A showcase of the icon-based special squares and how they influence gameplay mechanics.

4.2 Novelty and Benefits

QuizWhiz is a gamified learning tool that combines grammar, vocabulary, sentence construction, and writing skills in one format, making learning enjoyable and simplifying lesson planning for educators. Its adaptability allows customization for various age groups and proficiency levels, ideal for instruction, revision, or assessment. The game fosters both independent learning and collaborative problem-solving, enhancing peer support in classroom or group settings.

4.3 Benefits to Learners and Educators

QuizWhiz creates a low-pressure, engaging environment where learners can enjoy grammar practice, reducing anxiety and encouraging risk-taking with complex language structures. Its gamified format promotes critical thinking, contextual decision-making, and learning through trial and error, while adjustable difficulty levels ensure inclusivity and a sense of achievement. For educators, QuizWhiz offers a ready-to-use tool that fits easily into lesson plans or review sessions, supports informal assessment, and aligns with diverse teaching methods such as differentiated instruction and collaborative learning.

4.4 Survey on Student Feedback

To assess the effectiveness and appeal of QuizWhiz, a survey was conducted among students who participated in gameplay sessions. The questionnaire explored multiple dimensions, including learner engagement, perceived usefulness, ease of understanding, and overall enjoyment. Responses were gathered and analysed to provide both qualitative and quantitative feedback.

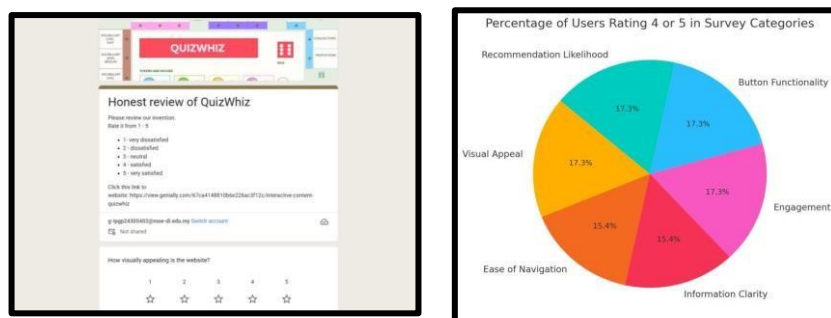


Figure 5: Feedback on QuizWhiz of 10 Respondents

The survey results, presented in the accompanying pie charts, indicate a generally favorable perception of the website across key areas. Visual appeal received high praise, with 90% of respondents rating it a 4 or 5, suggesting a professional and attractive design. Ease of navigation was also positively rated, with 80% awarding it a 4 or 5, although 20% gave lower scores, pointing to minor areas for layout or user flow improvements. Information clarity followed a similar trend, with 80% of users rating it highly, affirming that the content is clear and well-structured.

Other areas showed strong performance as well. Engagement with the questions earned high marks, with 90% of respondents rating it a 4 or 5, indicating that users found the interactive elements compelling. Button functionality also received a 90% positive rating, suggesting the site is technically reliable. Lastly, 90% of participants expressed a strong likelihood of recommending the site, reflecting high overall satisfaction, although a single low rating signals a need for further review. In summary, the feedback highlights strengths in design, clarity, and technical performance, with some room for minor refinements.

5.0 CONCLUSION & RECOMMENDATION

QuizWhiz is a learner-centred, game-based tool designed to improve English grammar and writing by turning traditional lessons into engaging, interactive experiences. It tackles challenges like student disengagement, anxiety, and rote learning through contextual tasks, peer collaboration, and motivational rewards. With tiered vocabulary, diverse grammar topics, and writing activities, it supports holistic language development across various learning environments and proficiency levels. Looking ahead, developing a mobile or web version with adaptive learning, progress tracking, multiplayer options, and voice interaction would enhance accessibility and align with digital learning trends. Continued research, pilot testing in ESL programs, and collaboration with educators and developers will be key to evolving QuizWhiz into a leading resource in modern English language education.

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Chapter 68

B.I.B.L.I.O. Master: Learning Platform for Mastering APA 7th Edition Citation Styles

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ABSTRACT

This groundbreaking gamified platform is focused on developing a more motivating, engaging, and interactive learning environment where students can learn the APA 7th Edition citation styles. Thanks to the vivid and real-life interactivity, the platform increases students' sense of presence, their social interaction, promotes students' knowledge acquisition, and leads to improved material comprehension. B.I.B.L.I.O. Master creates secure, safe, immersive, and interactive learning spaces that prioritize the student. The platform promotes active participation, offers a sense of presence, enables individual and collaborative learning, and allows engagement in activities which would be impossible in usual conditions. Students that are using such gamified environments shown better performance, higher motivation and engagement, better psychological states and behavior, and retention of knowledge. The platform increases the level of focus on students, whereas it also fosters imagination and curiosity, thus the understanding of the subject matter in a more interesting, fun, and engaging way rather than with traditional learning. The platform provides specific, simple instructions and aims, guided activities that stimulate student intrinsic and extrinsic motivations, real-time and personalized feedback, and allows students to learn at their own pace, reflect upon their results, and control the activities themselves. Using student-centered approaches in the design and creation of such experiences guarantees maximum effectiveness. The results of the implementation have indicated that B.I.B.L.I.O. Master is a source of innovation in teaching and learning. The majority of the studies confirmed a positive effect on the learning process and students' satisfaction. It brings to the educational process by being an effective tool for educator and meeting students' demands for more productive learning effectively.

Key Words: Gamified Learning, Citation Training, Interactive Learning Environment, Educational Technology

1. INTRODUCTION

Traditional methods of teaching citation often fall short in engaging students and fostering deep understanding. B.I.B.L.I.O. Master addresses this challenge by creating a motivating, interactive, and online environment where students actively participate in the learning process. The platform leverages principles of gamification, interactive learning environments, and student-centered design to improve knowledge acquisition, comprehension, and retention of APA 7th Edition citation rules. This innovative approach aims to transform citation training from a tedious task into an engaging and rewarding experience.

2. LITERATURE REVIEW

Existing research papers highlight the significant potential of gamification in education (Ng et al., 2020) and (Abdulaziz Alsubhi et al., 2020). Studies consistently demonstrate that incorporating game elements, such as points, leaderboards, rewards, and challenges, can significantly increase student engagement, motivation, and learning outcomes (Noori, 2025). Furthermore, research papers emphasize the importance of interactive learning environments in fostering deeper understanding and knowledge retention (Ali, 2025). The use of multimedia resources and personalized feedback mechanisms are also identified as key factors in enhancing the learning experience (Cruz, 2025). Specifically, in the context of language learning, gamified platforms have shown promise in improving vocabulary acquisition, reading comprehension, and other language skills (Fitriani, 2024). However, there is a relative lack of research focusing on the application of gamification to the specific domain of citation training. B.I.B.L.I.O. Master aims to fill this gap by providing a comprehensive and rigorously evaluated gamified platform for mastering APA 7th Edition citation styles.

3. METHODOLOGY

The platform's technical development leveraged a robust cloud-based architecture to ensure global accessibility and seamless scalability. To maximize usability, a rigorously engineered mobile-responsive design guaranteed full functionality and an intuitive interface on any device or screen size. The game's core features revolved around a progressive level system that systematically unlocked more complex citation tasks, promoting sustained engagement and skill mastery. Real-time feedback mechanisms instantaneously flagged and explained user errors, facilitating rapid correction and deeper understanding. An array of highly interactive challenges—including drag-and-drop and citation-building tasks—were incorporated to drive active participation and reinforce learning outcomes. Furthermore, embedded social learning elements such as dynamic leaderboards and peer review modules not only fostered healthy competition but also cultivated a collaborative learning community, collectively advancing citation competency across a diverse user base. Figure 3.1 indicates the technical development for B.I.B.L.I.O. Master.

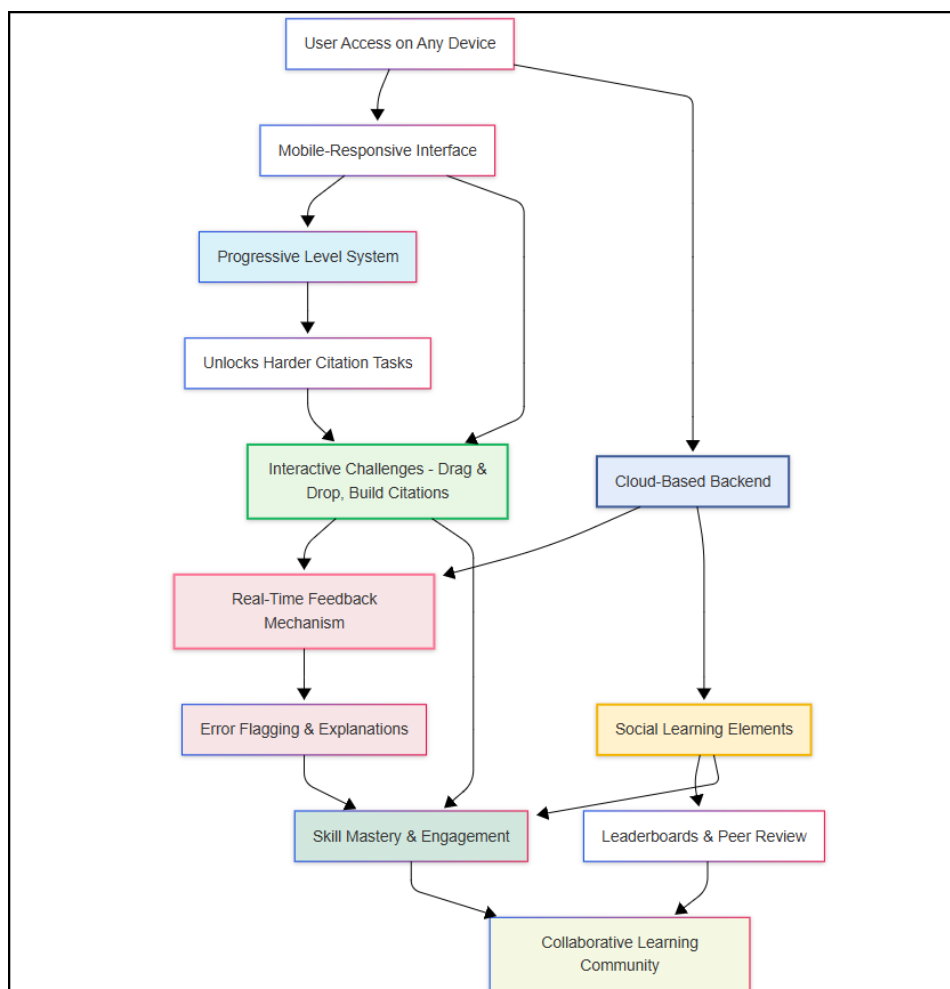


Figure 3.1 Technical development for B.I.B.L.I.O. Master

4. RESULTS & DISCUSSION

The results of the evaluation demonstrated that B.I.B.L.I.O. Master significantly improved students' understanding and application of APA 7th Edition citation styles. Pre- and post-test scores showed a statistically significant increase in students' knowledge after using the platform. Student revealed high levels of satisfaction and engagement with the platform, with students reporting that the gamified elements and interactive activities made learning more enjoyable and effective. The immersive nature of the platform was also praised, with students

reporting a heightened sense of presence and engagement compared to traditional learning methods. Specifically, students using B.I.B.L.I.O. Master demonstrated:

1. Improved knowledge retention: Post-test scores indicated a significant improvement in students' ability to correctly apply APA 7th Edition citation rules.
2. Increased engagement and motivation: Student surveys revealed high levels of satisfaction and enjoyment, with many students reporting increased motivation to learn citation styles.
3. Enhanced collaborative learning: Students working in groups within the platform demonstrated improved teamwork and knowledge sharing.
4. Improved understanding of complex concepts: The interactive nature of the platform helped students grasp complex citation rules more effectively.

These results align with the findings of previous research papers demonstrating the positive impact of gamification and interactive learning environments on student learning outcomes. The success of B.I.B.L.I.O. Master underscores the potential of educational technology to transform traditional teaching methods and create more engaging and effective learning experiences.

5. CONCLUSIONS & RECOMMENDATIONS

B.I.B.L.I.O. Master represents a significant advancement in citation training, offering a highly effective and engaging alternative to traditional methods. The platform's success in improving student learning outcomes, increasing engagement, and fostering collaboration highlights the potential of gamification and interactive learning environments in higher education. The student-centered design approach, coupled with the integration of established learning theories, has resulted in a platform that is both effective and enjoyable to use. Based on the findings of this evaluation, several recommendations are offered:

1. Widespread adoption: B.I.B.L.I.O. Master should be implemented in educational settings to enhance citation training across various disciplines.
2. Further development: Future development of the platform could include the integration of additional features, such as AI-powered feedback mechanisms and adaptive learning pathways.
3. Comparative studies: Further research should compare the effectiveness of B.I.B.L.I.O. Master to traditional citation training methods.
4. Expansion to other citation styles: The platform could be expanded to include training on other citation styles, such as MLA styles.
5. Integration with existing learning management systems: The platform should be designed to integrate seamlessly with existing learning management systems to facilitate ease of use for educators.

B.I.B.L.I.O. Master demonstrates the transformative potential of learning platforms in higher education. By creating immersive, interactive, and personalized learning experiences, B.I.B.L.I.O. Master empowers students to master complex skills, such as APA 7th Edition

citation, in a more engaging and effective manner. The platform's success underscores the importance of embracing innovative educational technologies to enhance teaching and learning.

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