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FOREWORD

The International Virtual Competition of Creative & Innovative Idea (IVCCII) 2026, organised by MNNF Network, stands as a unique platform that brings together creative thinkers, problem solvers, and innovators from diverse backgrounds. This competition encourages fresh ideas and practical solutions, providing a stage for both seasoned professionals and young minds to share their work.

This compilation of extended abstracts represents the depth and variety of submissions received. Each piece reflects a unique perspective, highlighting the participants' ingenuity and determination. From cutting-edge technological advancements to novel social solutions, these abstracts offer a glimpse into the promising future shaped by the next generation of innovators.

We extend our sincere appreciation to all participants, reviewers, and organisers who have contributed to the success of IVCCII 2026. It is our hope that this collection will serve as both a source of inspiration and a lasting record of the creative spirit that drives innovation forward.

Thank you for being a part of this journey.

Editor

Chapter 8
Ular Tangga Bijak Bahasa: A Gamified Constructivist Innovation for Malay Language Learning

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ABSTRACT

This study presents Ular Tangga Bijak Bahasa, a gamified constructivist innovation developed to enhance Malay language learning, particularly in morphology and syntax. Conventional grammar instruction in schools often relies on memorisation, drills, and teacher-centred approaches, resulting in low student motivation, weak conceptual understanding, and limited classroom participation. To address these challenges, the traditional snakes-and-ladders game was adapted into an interactive educational tool integrating gamification elements such as levels, rewards, progression, and immediate feedback with constructivist principles including collaboration, scaffolding, and active participation. The innovation was developed using the Design and Development Research (DDR) approach proposed by Richey and Klein (2007), involving needs analysis, product design and development, and pilot implementation. The game set consisted of a laminated A4 game board, 100-tiered question cards, coloured tokens, dice, and a teacher guidebook. Questions were organised into three progressive levels: morphology, syntax, and proverbs and wise sayings. Pilot implementation among secondary school students demonstrated encouraging findings, including a 45% improvement in morphology mastery, 95% positive student enjoyment, and 88% teacher satisfaction. The findings suggest that repeated exposure to grammatical concepts through collaborative gameplay enhanced students' motivation, participation, memory retention, and conceptual understanding. In addition, the innovation promoted 21st-century learning competencies such as communication, collaboration, critical thinking, and problem-solving. Due to its low cost, reusability, and practical classroom application, Ular Tangga Bijak Bahasa demonstrates strong potential as a scalable and impactful teaching aid for Malay language education.

Keywords: Gamification, Constructivism, Malay Language Learning, Morphology, Educational Innovation

1. INTRODUCTION

The transformation of 21st-century education demands teaching and learning approaches that are interactive, student-centred, and capable of enhancing active learner engagement. The Rancangan Pendidikan Malaysia (RPM) 2026-2035 emphasises meaningful learning experiences and innovative pedagogical practices to strengthen students' knowledge and skills. However, Malay language grammar instruction, particularly morphology and syntax, continues to face significant challenges in schools. Morphology is fundamental to Malay language structure because it involves word formation, affixation, and grammatical construction. Nevertheless, many students perceive

grammar lessons as difficult, abstract, and uninteresting. Nazihah Shaari and Zuraini Ramli (2025) reported that students remain weak in affixation and word formation, while Ramli and Shaari (2025) found that grammar lessons are often viewed as boring due to conventional teaching approaches. Similarly, Mat Rabi et al. (2020) argued that teacher-centred instruction limits meaningful understanding and reduces students' active participation in grammar learning.

Classroom observations revealed that students showed limited interest in grammar lessons that relied heavily on memorisation, drills, and routine exercises. Many students also struggled to remember concepts such as word classes, affixes, phrase structures, and sentence patterns, while classroom participation was often dominated by more confident learners. Although traditional "chalk-and-talk" approaches provide theoretical explanations, they frequently fail to sustain students' motivation and engagement. Therefore, there is a growing need for innovative teaching approaches that can make grammar learning more engaging, collaborative, and meaningful.

To address these challenges, Ular Tangga Bijak Bahasa was developed as a gamified educational innovation adapted from the traditional snakes-and-ladders game. The innovation transforms Malay grammar learning into an interactive and collaborative experience involving morphology, syntax, proverbs, and wise sayings. It integrates gamification elements such as levels, rewards, and immediate feedback with constructivist principles including collaboration, scaffolding, and active participation. Through tiered learning activities and group-based gameplay, students learn grammatical concepts progressively while improving their motivation, engagement, and mastery of Malay grammar in a meaningful and enjoyable learning environment.

2. LITERATURE REVIEW

2.1 Gamification in Language Learning

Game-based learning emphasises active participation, feedback, challenge, and social interaction as important elements in knowledge construction. Plass, Homer, and Kinzer (2015) explained that educational games support cognitive, motivational, affective, and sociocultural engagement when learning activities are meaningfully connected to game mechanics. Similarly, Deterding et al. (2011) defined gamification as the application of game design elements such as goals, rewards, levels, competition, and feedback in non-game contexts to increase engagement and motivation. Hamari, Koivisto, and Sarsa (2014) further noted that gamification produces positive educational outcomes when aligned with learners' needs and contextual factors. In Ular Tangga Bijak Bahasa, elements such as dice rolling, ladders, snakes, progression, and challenges are integrated to encourage repeated language practice and active student participation.

Previous studies in Malaysia and abroad demonstrate that gamification positively influences language learning. Nazihah Shaari and Zuraini Ramli (2025) found that gamification-based Malay grammar instruction was more effective than conventional teaching methods, while Felicia Nasip and Norehan Zulkiply (2024) reported improvements in reading comprehension through gamified learning activities. Studies involving Tamil and Arabic language instruction also showed increased motivation and academic performance among students. Internationally, Rofiah and Waluyo (2024) found that gamification reduced grammar-learning anxiety among Thai students, Shen et al. (2024) reported significant improvements in language achievement in China, and Abdulbaki et al. (2025) demonstrated better grammar mastery among students in Jordan and Saudi Arabia. These findings suggest that gamification creates enjoyable, interactive, and student-centred learning environments that support meaningful language acquisition.

2.2 Constructivism in Learning

This innovation is grounded in Vygotsky's Social Constructivist Theory, which emphasises that learning occurs through interaction, collaboration, and guidance from more knowledgeable

individuals (Vygotsky, 1978). A key constructivist concept is the Zone of Proximal Development (ZPD), which refers to the gap between what learners can achieve independently and what they can accomplish with assistance. Closely related to this concept is scaffolding, where instructional support is gradually reduced as learners become more capable of performing tasks independently. Studies by Darus Rohman and Endang Fauziati (2022) highlighted that gamification elements such as levels, progression, and challenges align closely with ZPD and scaffolding principles.

Wipapan Sankumpa (2023) identified five important constructivist elements in gamified learning environments: problem-based tasks, learning resources, collaboration, scaffolding, and guidance centres. These principles are embedded within Ular Tangga Bijak Bahasa through collaborative gameplay, peer discussion, progressive question levels, and teacher facilitation. During gameplay, students discuss answers, justify responses, and learn from peer and teacher feedback, transforming grammar learning from passive memorisation into active and meaningful experiences. The innovation also adopts a tiered learning structure involving morphology, syntax, and proverbs to support differentiated learning and gradual language mastery among students with varying ability levels.

2.3 Research Gap

Despite growing interest in gamification, previous studies have mainly focused on motivation, rewards, and engagement rather than systematic pedagogical model development for Malay morphology instruction. Research integrating gamification and constructivist principles specifically for Malay language learning remains limited. In addition, Malay grammar instruction still relies heavily on teacher-centred approaches and repetitive drills, which contribute to low student motivation and weak conceptual understanding. There is also a lack of innovative teaching materials that integrate Higher Order Thinking Skills (HOTS), collaboration, and meaningful language interaction.

Studies by Abdullah and Abdul Razak (2021) as well as Hambali and Lubis (2022) further highlighted that many gamification approaches focus excessively on rewards and superficial engagement without strong pedagogical foundations. Mohammad Hamad Al-Khresheh (2025) also emphasised that the effectiveness of gamification depends on systematic instructional design and clear empirical evaluation. Therefore, the development of Ular Tangga Bijak Bahasa addresses these gaps by integrating gamification and constructivist learning principles into a structured, low-cost, interactive, and student-centred innovation specifically designed for Malay grammar learning.

3. METHODOLOGY

This innovation employed a Design and Development Research (DDR) approach proposed by Richey and Klein (2007). DDR was selected because the study aimed to systematically design, develop, implement, and evaluate an educational innovation within authentic classroom settings. The approach ensured alignment between theoretical foundations, product development, classroom implementation, and evaluation processes.

3.1 Phase 1: Needs Analysis

The first phase involved identifying classroom problems related to Malay grammar learning through classroom observations and preliminary discussions with teachers and students. Several issues were identified, including weak mastery of Malay morphology and syntax, low student motivation towards grammar learning, overreliance on memorisation and repetitive drills, and limited innovative teaching materials for Malay language instruction. Many students perceived grammar lessons as difficult and uninteresting because teaching approaches were often teacher-centred and lacked meaningful interaction. These findings highlighted the need for a more interactive,

collaborative, and student-centred learning approach that could improve students' engagement and understanding of grammatical concepts.

3.2 Phase 2: Design and Development

The second phase involved adapting the traditional snakes-and-ladders game into a gamified Malay language learning tool known as Ular Tangga Bijak Bahasa. The original game structure was retained because it is simple, familiar, and suitable for collaborative classroom learning. Each square on the board was integrated with language tasks and tiered grammar questions based on different difficulty levels. The complete game set consisted of a laminated A4 game board, 100-tiered question cards, coloured tokens, dice, and a teacher guidebook. The questions were divided into three progressive levels: morphology, syntax, and proverbs and wise sayings to support differentiated learning, scaffolding, and gradual mastery of grammatical concepts. The materials were designed to be colourful, durable, and reusable, while the teacher guidebook provided instructions for gameplay and classroom implementation.

Figure 1: Product components of Ular Tangga Bijak Bahasa

3.3 Phase 3: Pilot Implementation and Evaluation

The third phase involved pilot implementation and evaluation of the innovation during classroom learning sessions among secondary school students. Students played the game in groups of two to four players. Each player rolled the dice, moved according to the number obtained, and answered Malay language questions based on the designated learning level. Correct answers allowed players to remain on the square, while incorrect answers required them to move back two squares. Landing on ladders rewarded players with upward movement, whereas landing on snakes resulted in setbacks. The first player to reach the final square was declared the winner. Throughout the activity, teachers acted as facilitators by monitoring gameplay, checking answers, encouraging peer discussion, and guiding students' understanding of grammatical concepts. Data collection during the pilot implementation involved classroom observations, student feedback, teacher feedback, and pilot achievement comparisons. The evaluation focused on determining improvements in morphology mastery, student engagement and enjoyment, and teacher satisfaction towards the innovation as a practical and motivating gamified learning tool for Malay language instruction.

4. RESULTS & DISCUSSION

The pilot implementation of Ular Tangga Bijak Bahasa demonstrated positive outcomes in terms of student engagement, motivation, and grammar mastery. The most significant finding was a 45% improvement in morphology mastery, indicating that repeated exposure to grammatical concepts through collaborative gameplay helped students recall and apply language concepts more effectively. Morphology is often perceived as abstract when taught through memorisation and written drills alone. However, in this innovation, students encountered grammatical concepts repeatedly through oral interaction, peer discussion, and contextual questioning, which strengthened memory retention and conceptual understanding while encouraging active participation.

Table 1 Summary of Pilot Implementation Findings

Aspect Evaluated	Findings	Interpretation
Morphology Mastery	45% improvement	Students demonstrated better understanding and retention of grammatical concepts through repeated exposure and collaborative gameplay activities.
Student Enjoyment	95% positive responses	Students found the learning activities enjoyable, interactive, and motivating, which increased active participation during lessons.
Teacher Satisfaction	88% positive responses	Teachers perceived the innovation as practical, manageable, effective, and suitable for classroom implementation.

Student responses towards the innovation were highly positive, with 95% of students reporting enjoyment during gameplay activities. Students actively discussed answers, negotiated meaning, and participated enthusiastically in the rewards and challenges created by snakes and ladders. The playful learning structure reduced fear of making mistakes and increased participation, consistent with Shen et al. (2024), who reported that gamification enhances learner motivation and engagement. The innovation also reflects constructivist principles through collaboration, peer explanation, guided support, and a tiered learning system aligned with the concepts of Zone of Proximal Development (ZPD) and scaffolding.

Teacher feedback further supports the classroom relevance of the innovation, with 88% teacher satisfaction recorded during the pilot implementation. Teachers viewed the innovation as practical, low-cost, durable, and suitable for classroom use, particularly in schools with limited technological resources. At an estimated production cost of RM8 per set, Ular Tangga Bijak Bahasa is affordable and reusable for long-term implementation. In addition, the innovation promotes 21st-century learning competencies such as communication, collaboration, critical thinking, problem-solving, and healthy competition through interactive gameplay activities. Nevertheless, the findings remain preliminary, and future studies should employ larger sample sizes, structured pre-test and post-test instruments, and more rigorous empirical analyses to strengthen the evidence for the innovation's effectiveness.

5. CONCLUSION & RECOMMENDATION

Ular Tangga Bijak Bahasa demonstrates strong potential as a gamified constructivist innovation for Malay language learning. By adapting the traditional snakes-and-ladders game into a structured educational tool, the innovation transforms grammar instruction into an interactive, collaborative, and enjoyable learning experience. The integration of gamification and constructivist principles enables students to learn through peer collaboration, scaffolding, discussion, and progressive challenges. Preliminary findings from the pilot implementation indicate positive outcomes in terms of grammar mastery, student enjoyment, and teacher satisfaction, suggesting that the innovation is both educationally meaningful and practically applicable in classroom settings. In addition, the

product is affordable, reusable, and easy to implement, making it suitable for schools with different levels of resources and technological access.

Several recommendations are proposed for future development. The question bank should be expanded and aligned systematically with curriculum standards and student proficiency levels, while examination-focused editions can be developed for SPM preparation. Digital and mobile application versions should also be produced to support online and home-based learning. In addition, multilingual adaptations may be explored to extend the innovation to other language subjects and broader educational contexts. Future studies should employ larger sample sizes and more rigorous empirical analyses to strengthen evidence regarding the effectiveness of the innovation.

In conclusion, Ular Tangga Bijak Bahasa contributes meaningfully to innovative Malay language pedagogy by combining educational theory, gamification, and practical classroom implementation within a single learning innovation. The innovation demonstrates that grammar learning can be academically purposeful, socially engaging, and enjoyable at the same time, with strong potential to become a scalable and impactful teaching aid for Malay language education.

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Chapter 9
SmartGrow Community: IoT Sustainable Agriculture Platform

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ABSTRACT
SmartGrow Community: IoT Sustainable Agriculture Platform is an innovative Internet of Things (IoT)-enabled solution developed to strengthen sustainable community-based agriculture through automation, efficient resource management, and digital accessibility. Community farms commonly depend on manual irrigation and fertilizer preparation, resulting in inconsistent nutrient application, excessive water consumption, high labour dependency, and reduced crop productivity. This innovation addresses these limitations through an integrated smart fertigation platform featuring automated nutrient mixing, programmable irrigation scheduling, real-time monitoring, and remote web-based control. The system integrates sensors, pumps, control modules, and a cloud-connected dashboard to ensure precise delivery of water and nutrients while minimizing operational inefficiencies and resource wastage. Its uniqueness lies in combining automated fertigation sequencing, dual operational modes for irrigation and fertilization, and centralized IoT monitoring within a modular platform specifically suited for community farming and educational deployment. SmartGrow Community enhances agricultural productivity, reduces operating costs, improves digital literacy among users, and supports resilient food production systems. The innovation also demonstrates commercialization potential as an affordable smart agriculture solution for community gardens, urban farms, educational institutions, and small agricultural enterprises. By bridging conventional farming practices with digital agriculture, SmartGrow Community contributes meaningfully to sustainable development through improved food security, responsible resource consumption, and climate-conscious agricultural management.

Keywords: Internet of Things, Smart agriculture, Irrigation, Fertigation

1. INTRODUCTION

Community-based agriculture plays an important role in strengthening food security, promoting social participation, and supporting sustainable livelihoods. However, many small-scale farming initiatives continue to rely on conventional irrigation practices and manual fertilizer preparation, which often result in inconsistent crop management, inefficient resource consumption, and labour-

intensive operations. These challenges limit productivity and reduce the long-term sustainability of community farming activities.

With the advancement of digital technologies, smart agriculture offers practical opportunities to improve farming efficiency through automation, real-time monitoring, and data-driven decision-making. Internet of Things (IoT) technologies have become increasingly relevant in modern agriculture due to their ability to automate processes, improve precision, and reduce resource wastage.

SmartGrow Community: IoT Sustainable Agriculture Platform was developed to address these challenges by introducing an accessible and practical IoT-enabled agriculture solution tailored specifically for community deployment. The project integrates automated irrigation, nutrient mixing, real-time monitoring, and remote operational control into a unified platform. The primary objectives of this project are to improve irrigation efficiency, automate nutrient delivery, reduce manual dependency, and promote sustainable agricultural practices through affordable smart technology.

2. LITERATURE REVIEW

Smart agriculture has gained increasing attention due to its capability to improve agricultural productivity while minimizing environmental impact. The integration of IoT technologies into agriculture enables precision farming through automated irrigation control, environmental monitoring, sensor-based data acquisition, and remote management (Wolfert et al., 2017). These technologies contribute to better decision-making and more efficient resource utilization.

Previous studies have reported that IoT-based irrigation systems significantly improve water-use efficiency while reducing labour dependency implementation (Zhang et al.,2021). Precision fertigation systems further enhance crop performance by enabling controlled and accurate fertilizer application based on predefined operational parameters. Such technologies support sustainable agricultural practices by minimizing excessive water and nutrient usage.

Despite these advancements, many smart agriculture systems remain expensive, technically complex, and primarily designed for commercial-scale (Kamble et al., 2020). This creates accessibility barriers for small-scale and community-based agricultural initiatives that often operate with limited financial and technical resources.

Community farming requires affordable, scalable, and user-friendly technologies that maintain functionality without excessive complexity. SmartGrow Community addresses this gap by integrating practical automation, IoT monitoring, and sustainable farming principles into a modular platform designed specifically for community use, educational applications, and small-scale farming deployment.

3. METHODOLOGY

SmartGrow Community was developed as an integrated smart agriculture platform combining mechanical, electrical, and digital technologies within a unified operational framework. The physical infrastructure consists of a main water storage tank, nutrient reservoirs for Fertilizer A and Fertilizer B, pumps, mixing tanks, valves, water level sensors, and irrigation delivery components.

The control architecture is built around an ESP32 microcontroller integrated with real-time scheduling functionality. This controller manages sensor data acquisition, process automation, operational logic, and wireless communication between the physical system and the cloud-connected monitoring dashboard. Users configure irrigation schedules, nutrient dosing duration, and operational modes through a centralized web-based dashboard. The system supports both automated and manual operational modes to provide flexibility according to user needs and field conditions, as shown in Figure 1.

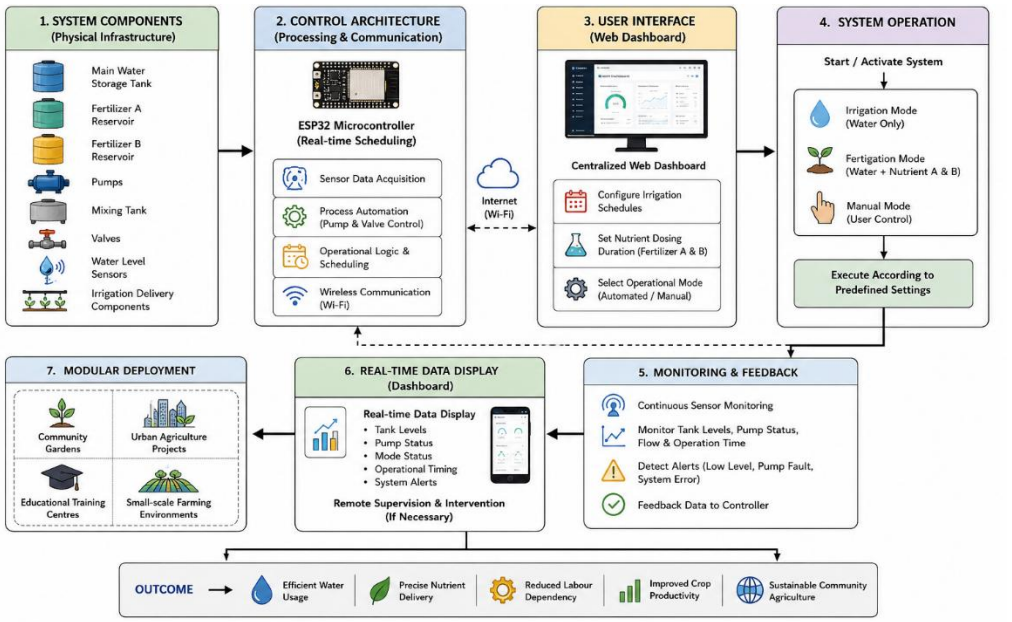

Figure 2: Methodology Flow Diagram of SmartGrow Community: IoT Sustainable Agriculture Platform

Once activated, the system continuously monitors operational parameters through sensor feedback and executes irrigation or fertigation processes according to predefined settings. Real-time system data, including pump status, tank levels, and operational timing, are displayed through the dashboard, enabling remote supervision and intervention when necessary. The modular design of SmartGrow Community allows flexible deployment in community gardens, urban agriculture projects, educational training centres, and small-scale farming environments.

4. RESULTS & DISCUSSION

The implementation of SmartGrow Community demonstrates significant practical and innovation value for sustainable agriculture applications. The integration of automated nutrient sequencing improves consistency in fertiliser preparation while reducing human errors commonly associated with manual operations, as illustrated in Figure 2. Scheduled irrigation improves water-use efficiency by ensuring controlled and timely water delivery based on predefined operational requirements. This contributes to reduced resource wastage and promotes more sustainable farming practices.

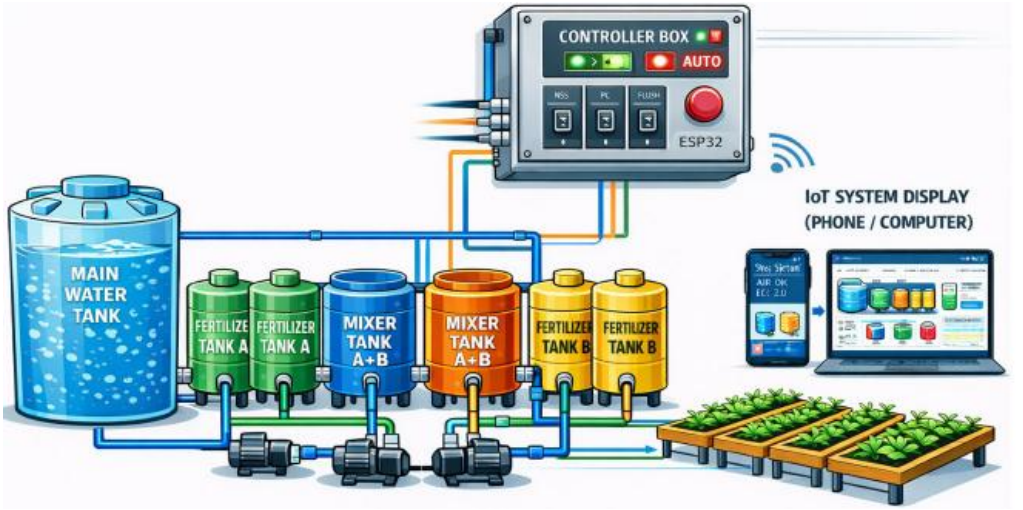

Figure 2: Configuration of IoT for the system

Real-time monitoring enhances operational visibility by allowing users to remotely track system performance and respond quickly to potential issues such as low water levels or equipment interruptions. This significantly reduces dependence on constant on-site supervision and lowers labour requirements.

Compared with conventional community farming practices, SmartGrow Community offers improved operational precision, greater consistency in nutrient delivery, and better overall resource management. Its modular architecture and affordability increase practicality for broader adoption in small-scale and community-based settings. From an innovation perspective, the system's uniqueness lies in combining automated fertigation sequencing, dual irrigation-fertilization operating modes, IoT monitoring, and remote control accessibility within a single integrated platform specifically designed for community agriculture.

Commercialization opportunities exist through modular smart farming kits, training packages, educational deployment, installation services, and smart agriculture consultancy applications. This strengthens the innovation's economic viability and scalability. The project also aligns strongly with sustainable development goals, particularly in supporting food security, responsible resource consumption, sustainable communities, and environmentally responsible agricultural practices.

5. CONCLUSION

SmartGrow Community: IoT Sustainable Agriculture Platform is a practical, scalable innovation that strengthens sustainable community-based agriculture through digital automation and efficient resource management. By integrating IoT monitoring, automated fertigation, remote access, and user-friendly operational control, the platform addresses inefficiencies commonly encountered in conventional farming systems, particularly in small-scale and community settings.

The innovation demonstrates significant environmental, social, and economic benefits by improving productivity, reducing operational costs, minimizing resource wastage, and strengthening digital literacy among community users. Its modular and affordable design enhances commercialization readiness and allows adaptation across multiple applications, including community gardens, urban farming, educational institutions, and small agricultural enterprises.

Future development may include predictive analytics using artificial intelligence, mobile application integration, renewable energy support, and expanded sensing capabilities to further improve system intelligence, sustainability, and scalability.

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