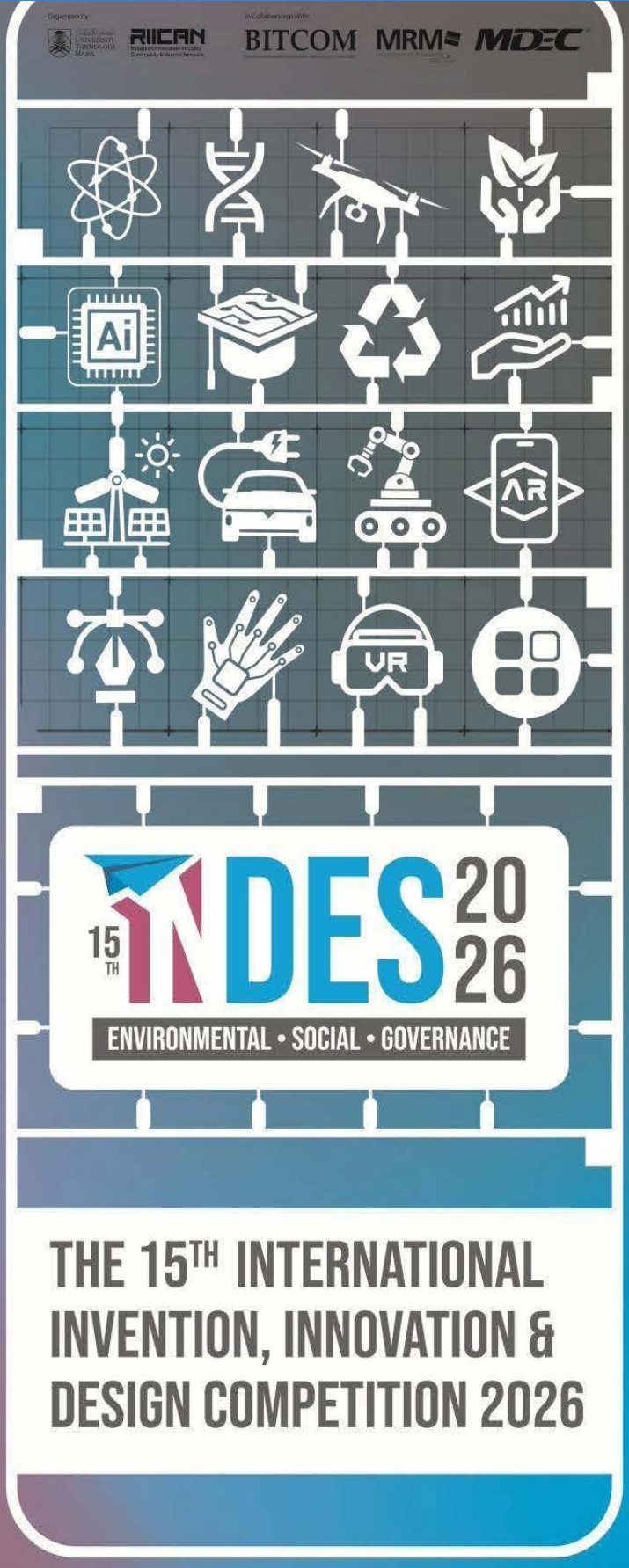


E-BOOK OF

EXTENDED ABSTRACT

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THE 15th INTERNATIONAL
INVENTION, INNOVATION &
DESIGN COMPETITION 2026

Organized by:
Office of Research, Industry,
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SPARKING CURIOSITY: A CROSS-DISCIPLINARY EXPERIENTIAL APPROACH TO STEM EDUCATION THROUGH INTERACTIVE FLIPBOOK DESIGN

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ABSTRACT

In many classrooms, STEM is often taught in a way that leaves students mostly reading or listening, with few chances for hands-on experience due to limited budgets and incomplete lab equipment. This can make scientific concepts seem abstract and hard to connect with real life. The Sparking Curiosity Flipbook is designed to change that. It's an interactive science handbook that brings together basic ideas from chemistry, physics, and biology through 17 simple experiments that use everyday, easy-to-find materials. The handbook isn't just for reading—it encourages students to write down their thoughts and observations as they work through each activity. Every experiment starts with a question to spark curiosity, gives step-by-step instructions, provides space for notes, and ends with a short explanation to help students conclude. This flipbook has been used in schools, at home, and in STEM programmes, where students showed higher participation and were more eager to try the activities compared to regular worksheets. When students can explore and observe directly, their understanding becomes much deeper and more meaningful. This approach provides a practical, accessible way to support hands-on STEM learning, even when resources are limited.

Keywords: *STEM Education, Interactive Handbook, Hands-on Learning, Science Experiments, Experiential Curriculum*

1. INTRODUCTION

Aligning with Malaysia's National STEM Policy and the Malaysia Education Blueprint (PPPM 2013–2025), there is a transition from passive, theory-heavy instruction to hands-on, inquiry-based learning to practical application. Despite these policy goals, science education often struggles to connect classroom concepts with real-world application, leading to a lack of student engagement. Research suggests that interactive tools and "learning-by-doing" are essential for deeper understanding and problem-solving (Herawati, 2024; Hartomo, 2024; Zucker et al., 2024). To address this challenge, the Sparking Curiosity project was developed to provide students with a practical STEM handbook that utilises common household materials for experiments. By transforming the home into an informal learning space and encouraging parental involvement, this project aims to make science relevant to daily life and foster the innovative mindset required for Malaysia's future workforce.

2. METHODOLOGY

2.1 Experimental Work

The initial stage of the project involved practical experimental testing conducted in a laboratory setting. A total of 17 hands-on STEM activities were carefully selected, executed, and categorized into three core scientific disciplines to ensure their safety, feasibility, and educational value. Table 1 shows the experiment done by field.

Table 1 Title of the hands-on STEM activities

Physics	Biology	Chemistry
○ Pyramid Hologram ○ LED Paper Circuit ○ String Rocket ○ Troll Basketball	○ Gummy Bears: Shrink or Swell ○ Bread Gone Fuzzy ○ Pond Pirates: Hunting Tiny Creatures ○ Strawberry Secret Codes ○ Build Your Own DNA Double Helix Origami ○ The Secret World of Ladybugs ○ Germ-Free Gel: Make Your Own	○ Gentle Bath Bomb ○ Elephant Toothpaste ○ Bubble Solution ○ Fire Bubbles (Teacher Demonstration) ○ Crystal Tree ○ Self-Inflating Balloon



Figure 1: Preparing the experiment and testing with a primary school student

2.2 Manual Development

After conducting experiments in the lab, we created a clear, easy-to-follow instructional manual through an iterative design process (see Figure 2). To make sure students and parents could easily understand each experiment, we used ChatGPT to rewrite the procedures and scientific concepts in simple, jargon-free language. We also used Canva to give the manual a clean, professional look with an intuitive layout. Each experiment includes clear instructions, a list of household materials, objectives, and important safety tips, making the manual both practical and user-friendly.

Figure 2. Process for developing the manual experiment book for biology, physics, and chemistry.



2.3 Flipbook Creation

The successful transition of the instructional manual into a dynamic digital flipbook resulted in a systematic, visually immersive resource that redefines STEM engagement through an intuitive, modular design. To ensure the pedagogical integrity and safety of the 17 curated experiments, a content validation process was undertaken, focusing on instructional clarity, risk mitigation, and age-appropriateness.

This phase involved meticulous refinement of procedural language to eliminate ambiguity and a strict vetting of materials to ensure only low-risk, household-accessible items were utilised, particularly for chemical reactions. By balancing simplified, bite-sized instructions with meaningful scientific depth, the flipbook was calibrated to serve both primary and secondary learners, resulting in a safe, versatile, and "fun" educational tool that transforms complex inquiry into an accessible and enjoyable shared experience for students and parents alike.



Figure 3. The final Flipbook

2. FINDINGS

The experiments foster high levels of interactivity and engagement by replacing passive reading with a "learning-by-doing" approach that positions students as active researchers. A central feature of this design is the integrated experiment record, which encourages students to sketch, write, and document live data in real-time rather than simply following a list of instructions. This shift from observation to active inquiry significantly increases student confidence and willingness to participate compared to traditional materials. By providing a dedicated space for reflection and using clear, accessible language, the activities reduce hesitation and promote critical thinking about scientific outcomes. Validation across diverse environments—including science camps and home-based learning—confirms that this interactive framework successfully transforms students from passive observers into active participants in scientific discovery.

The systematic development of the STEM flipbook successfully translated complex scientific concepts into an accessible and user-friendly format. Findings show that by integrating digital design tools and simplified language, the experiments became highly intuitive without losing their scientific accuracy. Validation confirmed that the focus on low-risk, household materials ensured a safe and practical experience for a wide range of age groups. Consequently, this method resulted in a versatile educational tool that effectively bridges the gap between theory and practice, fostering greater student confidence and engagement in hands-on scientific discovery.

3. CONCLUSION

The use of simple experiments combined with guided observation can improve student engagement in STEM learning. Presenting content in an interactive flipbook format encourages active participation and supports better understanding. This approach provides a practical option for introducing science concepts without requiring complex laboratory setups, making it suitable for a wide range of learning environments.

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