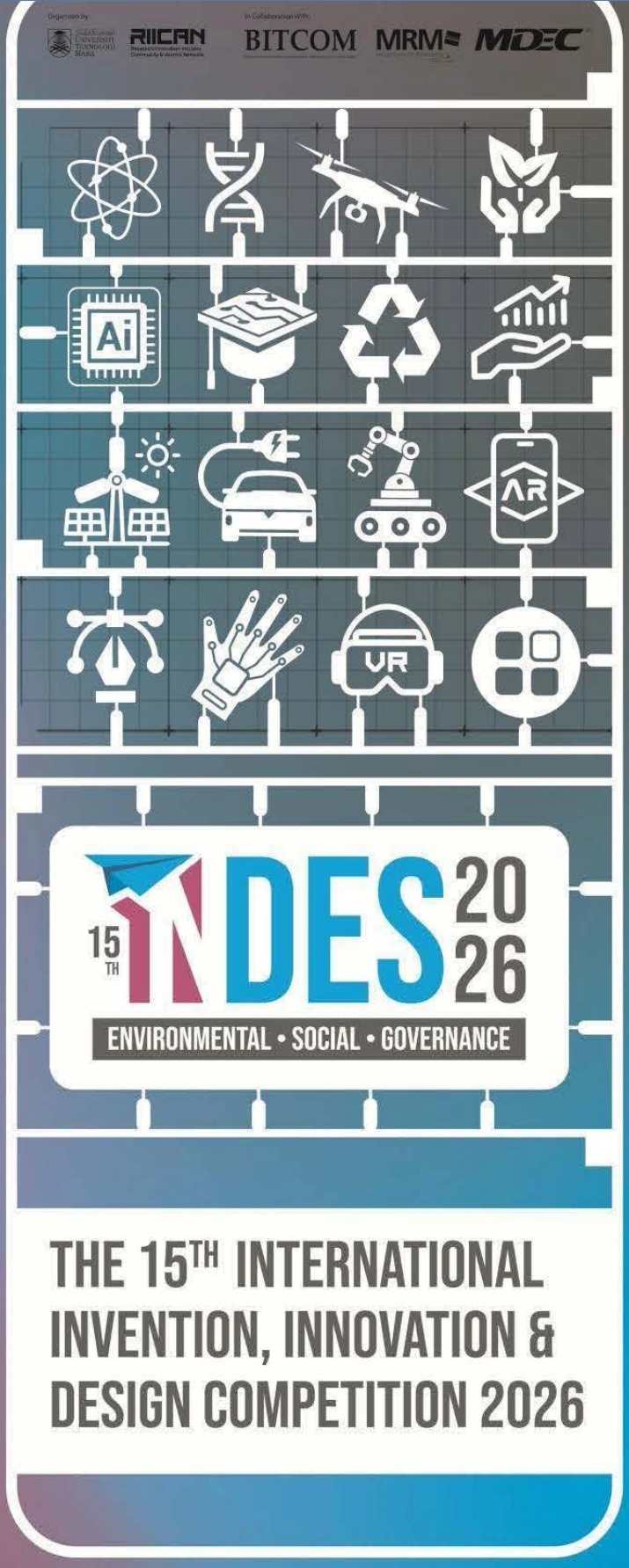

E-BOOK OF

EXTENDED ABSTRACT

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THE 15th INTERNATIONAL
INVENTION, INNOVATION &
DESIGN COMPETITION 2026

Organized by:
Office of Research, Industry,
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EDUDESK: AN INNOVATIVE EDUCATIONAL ACTIVITY TABLE DESIGNED TO IMPROVE COGNITIVE FUNCTION AND ADAPTIVE BEHAVIOR IN STUDENTS WITH INTELLECTUAL DISABILITIES.

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ABSTRACT

This study presents EduDesk, a manipulative-based educational activity table designed to enhance cognitive function and adaptive behavior in students with intellectual disabilities. Students with intellectual disabilities often face challenges in attention, working memory, problem-solving, and daily adaptive skills, requiring structured and concrete learning approaches. Research shows that manipulative and game-based methods improve engagement, conceptual understanding, and task performance; however, integrated tools that combine cognitive and behavioral training remain limited. EduDesk was developed using a design and development approach adapted from the ADDIE model, focusing on the Analysis, Design, and Development phases. The analysis identified learner characteristics and gaps in existing media, the design established learning objectives and product specifications, and the development produced a prototype validated by experts for pedagogical feasibility, functionality, and safety. Based on empirical evidence supporting structured and interactive interventions, EduDesk integrates cognitive stimulation and adaptive skill training into a practical learning medium with strong potential for future implementation in inclusive and special education settings.

Keyword: intellectual disability, manipulative learning, cognitive development, adaptive behavior, educational innovation

1. INTRODUCTION

According to the World Health Organization (2023), approximately 1.3 billion people representing 16% of the global population live with significant disabilities, positioning disability as a major global health and social concern. UNICEF (2021) further reports that nearly 240 million children worldwide have disabilities and experience greater barriers in accessing education, social participation, and optimal development than their non-disabled peers. Among developmental conditions, intellectual disability directly affects learning processes and is characterized by limitations in intellectual functioning and adaptive behavior across conceptual, social, and practical domains (American Association on Intellectual and Developmental Disabilities, 2021). Individuals with intellectual disabilities commonly experience difficulties in reasoning, problem-solving, planning, abstract thinking, and academic performance, necessitating structured and developmentally appropriate educational approaches. Research consistently indicates that these students benefit more from concrete, hands-on learning than from abstract or lecture-based instruction. A systematic review and meta-analysis by Park et al. (2018) demonstrated that manipulatives improve conceptual understanding and learning engagement, while Park and Bouck (2022) found that manipulative-based interventions enhance task accuracy and sustained attention. The National Center on Educational Outcomes (2023) also identifies manipulatives as evidence-based practices for supporting students with special needs.

Despite strong empirical support for activity-based and manipulative learning approaches, their integration into comprehensive and structured educational tools remains limited. Many educational settings continue to rely on conventional methods that do not fully integrate cognitive stimulation and adaptive behavior training within a single, accessible medium. Addressing this gap requires innovative instructional media that combine cognitive and behavioral development in a concrete and systematic format. EduDesk is therefore designed as an educational activity table incorporating guided manipulative games aimed at enhancing attention, working memory, basic problem-solving skills, and adaptive behavior in students with intellectual disabilities. This innovation is expected to serve as an evidence-based alternative to strengthen inclusive education and special education services.

2. METHODOLOGY

The development of EduDesk adopts a design and development approach aimed at producing learning media that aligns with the cognitive characteristics of students with intellectual disabilities. This study adapts the ADDIE instructional design framework (Analysis, Design, Development, Implementation, Evaluation). However, since the product is still in the early development stage, the process is limited to three phases: Analysis, Design, and Development.

The analysis phase focuses on identifying the conceptual and contextual needs for the development of EduDesk through literature review related to intellectual disabilities, activity-based learning, and manipulative learning media. This phase also examines common cognitive characteristics of students with intellectual disabilities, including limited attention span, working memory challenges, and difficulties in basic problem solving, as well as the limitations of existing learning tools in special education settings.

The design phase translates the analysis results into a structured product concept. At this stage, the EduDesk concept is formulated as a manipulative-based educational activity table designed to support cognitive stimulation and adaptive behavior development. The design includes determining learning objectives, cognitive indicators such as attention and memory, as well as preparing visual layouts and technical specifications of the product.

The development phase involves transforming the design concept into an initial prototype of EduDesk. Manipulative game components are integrated into the desk based on the defined learning objectives. The prototype design is then reviewed conceptually through expert validation involving special education and learning media experts to evaluate pedagogical, functional, and safety aspects. Revisions are conducted based on expert feedback to ensure that the product design is feasible for future implementation and field testing.

3. FINDINGS

The findings of this study suggest that structured game-based interventions positively influence the cognitive development of children with intellectual disabilities. Kim and Lee (2021) reported that game-based cognitive training significantly enhanced cognitive learning abilities compared to conventional instructional methods. Similarly, evidence from international peer-reviewed research consistently demonstrates that cognitive training programs targeting working memory, attention, and executive functioning will result in measurable improvements in academic performance.

Tlili et al. (2022) further provided a comprehensive review of game-based learning applications for learners with disabilities, emphasizing the cognitive and behavioral benefits of educational games. Children who participated in structured and adaptive game-based activities showed improved concentration, higher task completion rates, and greater engagement than those exposed to traditional approaches.

In addition, existing studies underline the importance of immediate feedback and reinforcement in maintaining motivation during learning tasks. Game-based interventions that incorporate progressive difficulty levels and multi-sensory stimulation create opportunities for repeated practice while

sustaining learners' interest. Duan et al. (2024) also demonstrated that structured physical play interventions improved both cognitive and social outcomes in children with intellectual developmental disorders. Evidence from randomized controlled trials supports the view that structured guidance and behavioral reinforcement strategies strengthen the overall effectiveness of cognitive training programs. Taken together, the literature supports the implementation of interactive and adaptive game-based tools as effective cognitive stimulation strategies in special education settings. These findings provide empirical justification for the development of structured educational innovations aimed at enhancing cognitive outcomes among children with intellectual disabilities.

Figure 1 EduDesk Prototype Design

4. CONCLUSION

This study highlights the importance of developing learning media that supports the cognitive and adaptive needs of students with intellectual disabilities. Based on literature evidence and the design and development process, EduDesk is proposed as a manipulative-based educational activity table that integrates cognitive stimulation and adaptive behavior training through structured and interactive learning activities. The development process, which follows the Analysis, Design, and Development phases of the ADDIE framework, ensures that the product concept aligns with learner characteristics and special education principles. Supported by previous research on game-based and manipulative learning approaches, EduDesk has the potential to enhance attention, and memory, and basic problem-solving skills among students with intellectual disabilities. This innovation may serve as an alternative learning tool to support inclusive and special education practices. Future studies are recommended to conduct implementation and field testing to evaluate the practical effectiveness of the product.

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