

A Conceptual Framework for a Hybrid Simulation-Based Intervention: Teaching Self-Management Skills to Primary School Students with Autism

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ABSTRACT - This study aims to develop a hybrid simulation-based intervention module that enhances self-management skills among primary school students with autism. The module combines face-to-face instruction with digital technology through augmented reality (AR) combined with limited virtual reality (VR). This design creates interactive environments that closely resemble real-life situations. It enables students to practice daily routines in a structured, repetitive and meaningful manner to support long-term skill acquisition.

The research applies the Design and Development Research (DDR) methodology guided by the Sidek Module Construction Model, which comprises three sequential phases. The first phase involves a comprehensive needs analysis using questionnaires administered to special education teachers followed by semi-structured interviews with selected experts. This phase applies McKillip's model to systematically identify gaps in existing instructional practices and uncover specific challenges faced by teachers in teaching self-management skills to primary school students with autism. Through this process, stakeholders' expectations, current teaching realities and desired performance outcomes are analyzed to determine the precise needs that the Hybrid Intervention Teaching Module must address.

The second phase focuses on developing the module content and refining its instructional design through structured expert consultation. Piaget's cognitive development theory guides the progression of self-management tasks, starting with concrete activities and gradually advancing to abstract concepts to match the developmental stage of primary school students with autism. Mayer's multimedia learning principles support the integration of visual, auditory and interactive elements to enhance comprehension. Sweller's cognitive load theory informs the organization of content to reduce unnecessary complexity and facilitate focused learning. The Modified Nominal Group Technique (mNGT) is used to obtain expert input. Following this, the Fuzzy Delphi Method (FDM) refines the findings by reaching consensus on the simulation tasks and confirming content validity.

The third phase evaluates the module using the TUP (Technology, Usability and Pedagogy) model. Technology integration is reviewed to confirm its compatibility with the classroom infrastructure. Usability assessment examines teacher and student interactions to evaluate navigation efficiency as well as accessibility. Pedagogical alignment is reviewed to ensure the module supports established teaching practices for students with autism. Feedback from teachers during classroom use is analyzed and used to refine the module. This process ensures the hybrid simulation remains relevant to Malaysian primary schools and provides a dependable tool for teaching self-management skills.

INTRODUCTION

The rising number of students with autism in Malaysian primary schools underscores the urgent need for effective and targeted educational interventions. The Department of Social Welfare (2025) reported that by February 2025, 70,208 individuals were registered with learning problems classified as autism, representing 23% of all such cases in Malaysia. Previous data indicate an 815% increase in the total number of children with autism, rising from 6,991 cases in 2013 to 63,966 cases in September 2024 (Utusan Malaysia, 2024). This significant growth highlights the pressing need for proactive measures, particularly within the field of special education. Autism is a neurodevelopmental disorder affecting communication, social interaction and behavior which directly impacts students' ability to adapt to learning environments (Chow & Mohd Salleh, 2021). Consequently, the development of effective and tailored interventions is critical. Module development involves designing developing and systematically evaluating learning materials to achieve specific educational objectives (Siraj, Abdullah & Rozkee, 2020; Richey & Klein, 2007). Intervention teaching modules are specifically designed to support students with special needs through training customized to their unique requirements (Ramli et al., 2025).

Self-management skills are an important basis for autism students to live their daily lives more self-reliant. However, challenges such as communication weaknesses, social interactions and difficulties adapt to daily routines make it difficult for them to master these skills effectively (Chow & Mohd Salleh, 2021). Self-management interventions have been identified as one of the most potential evidence-based practices (EBP) in helping autism students achieve a variety of positive learning outcomes (Steinbrenner et al., 2020). However, the implementation of existing interventions is often limited to highly defective students and does not take into account the unique needs of individual autism (Villamin & Luppicini, 2024).

In line with technological developments, a hybrid intervention approach that combines face-to-face and digital methods is increasingly accepted as an effective learning strategy in special education (Ministry of Higher Education, 2024). Studies show that a hybrid approach that integrates visual and multisensory strategies can enhance the understanding of academic concepts among autism students (Ahmad et al., 2021; Hashim et al., 2022). It acts as a reflection of real-world situations that enable students to experience and understand a concept or procedure in depth (Gadge, 1985; Noriati Rashid et al., 2015; Maidin & Bakar, 2020). In addition, the learning approach through play has been identified as an effective way of engaging and increasing the involvement of autism students in learning (Haslida, 2015; Aimi Najlaa & Faridah, 2017; Auni Bazilah & Mohd Jasmy, 2019; Arumainathan, Kway, & Shaffeei, 2023). Mobile applications that combine simulation elements and educational games can support accessibility needs and provide personalized learning experiences for autism students (Villamin & Luppicini, 2024). Although various interventions have been introduced, constraints such as incompatibility with all levels of student ability, lack of long-term assessment and actual implementation issues in the classroom continue to be a major challenge (Villamin & Luppicini, 2024). Therefore, a form of a flexible, fun, accessible and supportive intervention is essential to help autism students master their self-management skills more effectively.

Due to identified issues, this study was conducted to develop and evaluate the effectiveness of hybrid intervention teaching modules using mobile simulation, with the aim of helping primary school autism students master self-management skills. This module is systematically designed based on specific learning objectives and integrates various strategies and learning media. Teachers will play an important role as a key planner and facilitator in ensuring that the implementation of the Hybrid Intervention Teaching Module is effective, in line with the aspirations of the Education Strategic Plan 2024-2030 (Ministry of Education Malaysia, 2024).

The Design and Development Research (DDR) approach is used to ensure that the module development process is implemented systematically and effectively (Richey & Klein, 2007; Mohd Ridhuan & Nurul Rabihah, 2021). The Sidek Module Construction Model was selected as a guide as it provides a clear, structured and systematic module development framework. Sidek Mohd Noah and Jamaludin Ahmad (2008) emphasize that module development follows a structured process with three primary phases such as needs analysis, design and development, followed by implementation with evaluation. This framework essential to ensure the module is effective, practical and tailored to the learners' needs. Therefore, the Sidek Module Construction Model is the main reference in organizing the content and activities of the module, while the DDR approach ensures that each development phase

is implemented regularly. The combination of DDR approaches and the Sidek module construction model not only strengthens the accuracy of the module development process but also enhances its effectiveness in meeting user needs.

Figure 1: Development Conceptual Framework for a Hybrid Intervention Teaching Module for Primary School Students with Autism Based on Self-Management Simulation

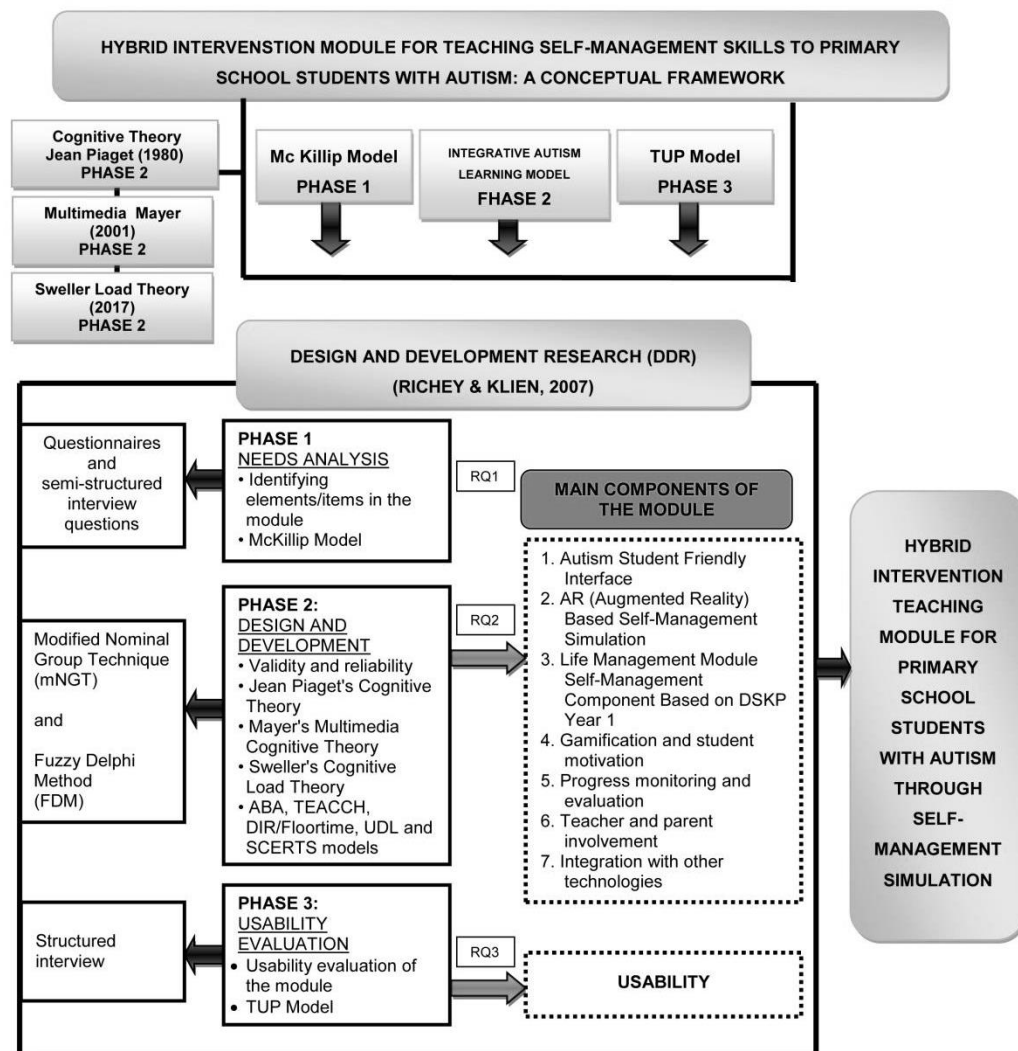
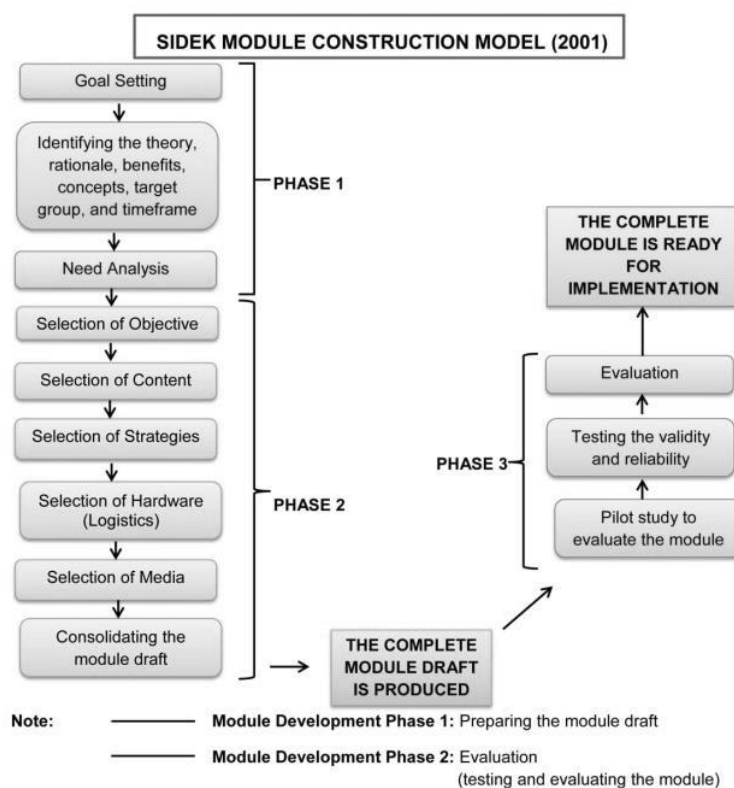


Figure 2: Adaptation of the Sidek Module Construction Model (Sidek Mohd Noah & Jamaludin Ahmad, 2008) in the development of Hybrid Intervention Teaching Module Primary School Autism through Self-Management Simulation



PROBLEM STATEMENT

Students with autism spectrum disorder (ASD) often struggle to master self-management skills that are essential for daily functioning and academic success. Existing interventions are frequently limited because they are not tailored to individual developmental profiles, reducing their relevance and effectiveness (Williams et al., 2024).

In addition, standalone Virtual Reality (VR)-based interventions often face significant challenges, including sensory overload, high cognitive load, limited generalization of skills to real-world contexts, high costs and insufficient teacher training support (Yang, X., Wu, J., Ma, Y., Yu, J., Cao, H., Zeng, A., Fu, R., Tang, Y., & Ren, Z., 2025; Altın, Boşnak, & Turhan, 2025). Many current approaches also lack interactive and visual components, making it difficult for students to comprehend concepts and sustain motivation (Mar'atullatifah et al., 2022). Augmented Reality (AR) offers potential to enhance engagement and understanding by presenting information visually and interactively.

However, current interventions rarely incorporate AR or structured simulation-based elements that allow students to practice self-management in controlled yet realistic environments (Villamin & Luppini, 2024). The absence of such elements limits opportunities for skill application and generalization to real-world contexts.

This study aims to design, develop and evaluate a hybrid intervention that integrates immersive simulation technology to enhance self-management skills among primary school students with autism. The module integrates virtual and augmented reality within a structured teaching framework to provide realistic yet controlled environments for students to practice essential daily routines. In parallel, it empowers teachers to facilitate guided learning and systematically monitor students' progress.

OBJECTIVE

The purpose of this study has been following specific research objectives, which are:

1. Identify the development requirements of the Hybrid Intervention Teaching Module for primary school autism students through self-management simulations based on existing teaching challenges and needs.
2. Designing and developing a Simulation-Based Hybrid Intervention Teaching Module to assist teachers in planning the teaching of autism students' self-management skills.
3. Evaluate the use of the Hybrid Intervention Teaching Module in supporting the role of teachers as a planning for teaching self-management skills for autism students.

In line with the objectives stated, this study will answer the following questions:

1. What is the need for the development of hybrid intervention teaching modules for primary school autism students through self-management simulation?
2. How can a simulation based hybrid intervention teaching module be designed and developed to support teachers in planning the teaching of autism students' self-management skills?
3. To what extent is the use of the Hybrid Intervention Teaching Module in enhancing teacher competencies as a planning for teaching self-management skills for autism students?

METODOLOGI

This study employed the Design and Development Research (DDR) approach, as proposed by Richey and Klein (2007), to develop a hybrid teaching intervention module for primary school students with autism using self-management simulation. DDR was selected due to its systematic, phased and dynamic nature, allowing the development and evaluation of educational interventions based on actual user needs. The integration of cognitive and multimedia theories in each DDR phase enhances interactive learning and improves module effectiveness. Relevant experts were consulted to ensure validity and effectiveness of the module, while maintaining expert confidentiality to avoid external influence.

Research Design

The study aimed to develop a hybrid teaching intervention module tailored for primary school students with autism to help them acquire daily living skills through self-management simulation. The DDR approach was employed to provide a systematic, stepwise method for developing and evaluating interventions based on user needs. Adaptation of DDR to the Malaysian educational context was carried out using a three-phase structure, in line with Saedah Siraj et al. (2013). The module also followed the Module Development Model by Sidek (2008), providing guidance on content selection, activity sequencing and assessment strategies, ensuring that the developed module is practical, comprehensive and suitable for teaching students with autism. A needs analysis was conducted to identify areas for improvement in innovative pedagogy, as recommended by Yusoff et al. (2022).

Participants

The study involved special education teachers serving in Malaysian primary schools, based on the 2024 Special Education Data from the Special Education Division, Ministry of Education, which reported a total population of 10,262 teachers. The quantitative sample size was determined using Krejcie and Morgan's (1970) formula, resulting in 370 teachers who completed questionnaires on challenges in teaching self-management skills and module requirements. For the qualitative phase, four experts participated in semi-structured interviews, comprising autism-specialized special education teachers, multimedia technology specialists, language experts and self-management specialists. During the design phase, 11 experts engaged in a Modified Nominal Group Technique (mNGT) session to establish consensus on module elements, while 20 experts contributed to a Fuzzy Delphi Method (FDM) to refine the module's content and structure. In the usability evaluation phase, five senior special education teachers with over 15 years of experience assessed the module's effectiveness and appropriateness. The use of Delphi-related methods was informed by prior studies emphasizing expert

consensus as a robust approach for tool and module development in autism research (Tangkilisan, Rivas Vazquez, & Zuckerman, 2025).

Location and Equipment

This study was conducted in selected primary schools offering the Special Education Integration Programme (SEIP) for students with autism. These locations were chosen because they were easy to access, had suitable participants and showed readiness to implement technology-based learning. The hybrid intervention for self-management was delivered mainly through an augmented reality (AR) mobile learning application that provided interactive, step-by-step simulations. Virtual reality (VR) was included in a limited number of modules where an immersive experience could better support the learning of daily routines, such as dressing or personal care. The equipment used included Android tablets, smartphones with AR capabilities, low-cost VR headsets for specific activities, as well as visual prompts and task cards to reinforce each learning step.

A chat box was integrated into both the AR and VR components to act as a personal guide for the students. Through this feature, learners could receive clear instructions, ask simple questions, or respond to prompts during their practice. The chat box supported both text and voice-to-text input, making it easier for students with limited writing or typing skills to participate. Colour-coded buttons with clear icons, accompanied by short and simple feedback messages, were applied to make the interaction intuitive while reducing cognitive load. Teachers could also review the chat history to track progress and adjust support based on each learner's needs.

RESEARCH FINDINGS

So far, no detailed decision or discussion has been made as the planned hybrid intervention module has not been fully developed. Therefore, this study presents a conceptual framework for the development of hybrid intervention teaching modules specifically for autism students, based on self-management simulation. This hybrid approach enables teachers to apply modules in teaching sessions, while giving students and parents access to continuous support at home, thus strengthening holistic self-esteem.

DISCUSSION

This study proposes a conceptual framework for a hybrid simulation-based intervention designed to enhance self-management skills among primary school autism students. The framework was developed through a systematic needs analysis and theoretical synthesis to address persistent challenges faced in supporting daily routine mastery within special education contexts. By integrating structured teaching approaches with digital simulation tools, it establishes a foundation for more adaptable and engaging learning environments.

The framework is theoretically grounded in multiple evidence-based models that collectively emphasize structure, reinforcement, interactive engagement and flexibility in learning. These elements are particularly relevant for autism students who often benefit from visual guidance, repetitive practice and clearly defined routines. Unlike conventional methods that rely predominantly on teacher-led instruction, this hybrid approach combines traditional face-to-face delivery with interactive simulation, offering opportunities for safe, repeatable and independent practice before real-world application. This approach reflects a shift from solely direct instruction towards blended modalities that prioritize autonomy, gradual skill acquisition and active learner participation.

One of the key strengths of this framework lies in its ability to bridge gaps in current special education practices, where technological integration is often limited or inconsistently applied. By incorporating simulation, it allows educators to scaffold learning experiences that are individualized and contextually relevant, particularly for essential daily living skills such as dressing, grooming and managing personal care. Furthermore, it provides a structured yet flexible pathway for teachers to enhance their professional practices without over-reliance on traditional rote methods.

Despite its potential, several implementation challenges are anticipated. Variations in technological readiness, disparities in school resources and the need for consistent professional training may influence the uptake and sustainability of such an intervention. These challenges highlight the importance of strategic planning, infrastructure support and targeted capacity-building among educators.

Although this framework has not yet undergone empirical evaluation, its conceptual clarity and alignment with recognized instructional principles position it as a significant step toward modernizing interventions in special education. It contributes to the growing body of research advocating for hybrid and simulation-based approaches that respond to the diverse needs of autism students while promoting functional independence.

In essence, the framework offers a novel direction for integrating structured teaching with immersive technology to strengthen self-management skills in primary education settings. Future work will focus on refining its design, ensuring usability and embedding it within broader instructional planning to maximize its practical impact.

IMPLICATIONS

This study has a significant impact on the field of special education, especially in the development of hybrid intervention teaching modules based on self-management simulation for autism students in primary schools. The development of modules needs to be implemented systematically through needs analysis, design and development, implementation together with evaluation (Sidek Mohd Noah & Jamaludin Ahmad, 2008). In this regard, the Sidek Module Construction Model is used as a key framework in this research to ensure that the modules are structured, structured and meet the learning needs of autism students. The findings of this study are valuable for teachers, help improve the learning experience of students with autism and assist schools in their programs, with positive implications for the Ministry of Education Malaysia. Special education teachers benefit through this module as they enable them to plan and use more effective teaching techniques. A study by Richey & Klein (2007) emphasized that the development of modules should take into account its uses in improving the learning experience.

The modules developed in this study also provide practical guidance for teachers in teaching students of autism students more interactive and easy to understand. In addition, the application of innovative and student-centered teaching strategies can enhance their learning effectiveness. The impact of this study also has a direct impact on autism students by helping them learn to take care of themselves through simulation experiences that resemble real situations.

Mar'atullatifah et al. (2022) states that the use of technologies such as Augmented Reality (AR) can make learning more fun, easy to understand and help autism students learn more effectively. As a move to improve special education, i-Urusdiri mobile applications have been developed as digital tools to support special education students' self-management skills (R. Zubir et al., 2023). The simulation element in this module provides students with the opportunity to practice self-management skills in a controlled but realistic environment, which in turn enhances their efficiency in the face of real world challenges (Villamin & Luppisini, 2024).

Altın, Boşnak & Turhan (2025) conducted a systematic review on the use of virtual reality (VR) to support social skills among children with autism spectrum disorder. They found that while VR offers an engaging and safe environment for students to practice interactions, its effectiveness strongly depends on the involvement of teachers and structured guidance. VR alone often lacks the contextual reinforcement needed for children to transfer these skills into their real-life situations. Therefore, interventions must not only include VR technology but also provide teacher-facilitated strategies, clear learning goals and opportunities for repeated practice. A study by Williams et al. (2024) also stated that interventions adapted to the specific needs of autism students are more effective in improving their learning. Schools and Ministry of Education Malaysia also benefited from this study in an effort to strengthen special education. This study has the potential to be used in drafting a more effective special education policy taking into account the role of technology in teaching. Therefore, the results of this study can be referenced by the school in introducing a more systematic new approach to supporting the learning of autism students, thus contributing to the overall quality of special education in Malaysia.

CONCLUSION

This study proposed a conceptual framework for a Hybrid Simulation-Based Intervention Teaching Module designed to strengthen self-management skills among primary school autism students. Guided by three main objectives, the study first identified the development requirements of such a module based on existing teaching challenges and needs. It then outlined a structured approach for designing and developing the module, integrating simulation-based learning with hybrid teaching strategies to assist teachers in planning more effective interventions. Finally, it set the direction for evaluating the use of this module in supporting teachers' roles as planners and facilitators of self-management skills.

The framework responds to three central research questions: the need for a hybrid intervention module in the current teaching context, the process of designing and developing it to align with the specific requirements of autism education and the extent to which its use can enhance teacher competencies in planning targeted interventions. By addressing these questions, the framework not only lays a strong foundation for the systematic development of the module but also positions technology-supported learning as a practical solution to bridge existing gaps in the teaching of self-management skills.

Although empirical testing has not yet been conducted, this study has provided a clear conceptual direction that will inform subsequent phases of module development and usability evaluation. Its potential lies in improving functional independence among autism students while offering teachers a structured, adaptable and effective tool for intervention planning.

CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this paper. All stages of the research, including data collection, analysis, and interpretation, were conducted objectively and independently, without any external influence.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest. This includes financial, political, personal, or professional relationships that could be perceived as influencing the content or conclusions of this manuscript.

AUTHORS CONTRIBUTION

All listed authors have made a significant scientific contribution to the research in the manuscript, approved its claims, and agreed to be an author.

DECLARATION OF GENERATIVE AI

During the preparation of this work, the authors used ChatGPT (OpenAI) to enhance the clarity and readability of the manuscript. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

ETHIC STATEMENTS

Not applicable.

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