*International Journal of Learning, Teaching and Educational Research*
*Vol. 24, No. 1, pp. 87-115, January 2025*
*https://doi.org/10.26803/ijlter.24.1.5*
*Received Nov 25, 2024; Revised Jan 14, 2025; Accepted Jan 18, 2025*

# Application of ADDIE as an Instructional Design Model in the Teaching and Rehabilitation of Children with Autism: A Review

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**Abstract.** The analysis, design, development, implementation, and evaluation (ADDIE) model is widely used in the field of education, based on rich instructional programs or materials that have been developed for instructors and students. However, the use of the ADDIE model in teaching and rehabilitating children with autism has not been systematically reviewed to date. The objective of the study was to discuss the use and effectiveness of instructional design based on the ADDIE model in the teaching and rehabilitation of children with autism. A literature search was undertaken using three databases (Web of Science, Google Scholar, and CNKI), and 36 studies on the use of the ADDIE model in teaching and rehabilitating children with autism from 2010 to 2024 were reviewed according to the PRISMA checklist. Results show that studies on the application of the ADDIE model for the teaching and rehabilitation of children with autism were the most numerous in 2023, with Malaysia and Indonesia having the highest number of studies. The types of papers were mostly journal papers, and most of them were based on quantitative research and used multiple data collection methods. Various studies have shown that instructional programs or materials developed based on the ADDIE model have positive effects and impacts on multiple developmental domains for children with autism. This study comprehensively analyzed the situation and effects of ADDIE as an instructional design model in teaching and rehabilitating children with autism, aiming to provide a reference basis for future researchers and educators.

**Keywords:** ADDIE model; children with autism; instructional design; review; teaching and rehabilitation

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## 1. Introduction

The ADDIE model is a model of instructional design based on analysis, design, development, implementation and evaluation. It was first developed by the Center for Research in Educational Technology at Florida State University (Cahyadi, 2019). Analysis is mainly used to analyze problems related to issues with teaching and learning, such as instructional needs and the current situation. Design usually involves designing and laying out the overall teaching and learning process after determining the instructional objectives and content. Development usually involves the development of the required materials and media based on the designed objectives and content. Implementation refers to the implementation of the developed instructional module in a real-life situation. Evaluation refers to the evaluation of the effectiveness and usability of the developed modules after implementation (Reiser & Dempsey, 2012). Each phase of ADDIE provides the basis and prerequisite for the next phase, and each phase is independent and interrelated (Spatioti et al., 2022). The development of teaching content using ADDIE is due to the model's inherent strengths: comprehensiveness, flexibility, and adaptability (Bu, 2014; Iftitah, 2023).

Currently, ADDIE is widely used in the field of special education. Nagata and Kimura (2020) developed a teaching framework using the ADDIE model in order to improve the ability of children with intellectual disabilities to avoid their own dangers; it had good results. Ratnawulan et al. (2023) concluded that children with intellectual disabilities lacked hands-on skills, and it was surmised that hands-on skills affected the future life and development of the children. So, based on the ADDIE model, they developed an application which covers areas from preparing materials to repairing tools, and it is mainly used to improve children's hand movements and hands-on skills. Winarsih and Pianora Sarris (2018) designed a game for children with hearing impairment based on the ADDIE model, and it is mainly used to improve their reading ability and language comprehension as well as their capacity to express themselves. Yahya and Tahar (2017) focused on the fact that children with learning disabilities face obstacles in remembering words and so they developed a corresponding teaching program to help children with learning disabilities to deepen their knowledge and memory of vocabulary by understanding the specific meaning of each word. In conclusion, it can be seen from the above research cases that the ADDIE model has become an important tool in teaching in the field of special education, and that this model can effectively help children with intellectual disabilities, children with hearing impairments, and children with learning disabilities with different aspects of their difficulties.

In the *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition (DSM-5), the main characteristics of autism spectrum disorders (ASD) are described as a lack of social skills and communication, restricted interests, and repetitive patterns of behavior (American Psychiatric Association, 2013). According to the latest data, the prevalence of ASD is on the rise; for example, data from the Centers for Disease Control and Prevention (CDC) shows that the prevalence of ASD in the United States has increased from 2/10,000 to 1/54 (Maenner, 2023).

Data released by a Chinese organization in 2022 suggests that China currently has approximately 3 million children with autism (Zhang, 2022).

It is worth noting that the number of children with autism is increasing, but there is still no specific medication to treat the condition, as the neurobiological basis of the disorder and its pathogenesis are still unclear (Lord et al., 2020). Based on this background, education and rehabilitation are nowadays the best way to improve the symptoms of children with autism (Sandbank et al., 2020). The focus of education and rehabilitation for children with autism is on designing different programs for them according to their varying developmental levels and needs (Iovannone et al., 2003). Some studies have shown that rehabilitation training can effectively improve core symptoms and cognitive functioning in children with autism and exert long-term rehabilitation effects (Zhang et al., 2019).

In a similar way to children with other disorders, children with autism have significant individual variability, with differences in developmental levels and targeted rehabilitation needed for each individual (Trembath & Vivanti, 2014). The ADDIE model, which is both flexible and comprehensive, is becoming an important modeling tool for the development of instructional and rehabilitative content for children with autism. According to van Merriënboer (2013), the ADDIE model can be used in conjunction with other instructional theories and principles to make instructional design more effective. The ADDIE model can assist in the standardization process of instructional design and ensure the quality of instruction (Guo, 2014).

A search of the literature revealed that to date there has been no systematic review of research related to the use of the ADDIE model in the teaching and rehabilitation of children with autism compared to children with other types of disorders, to the extent that there is a lack of literature references on the application of the ADDIE model in the teaching and rehabilitation of children with autism and on the specific effectiveness of the ADDIE model in this context. Therefore, the present study focuses on a systematic review of the use of the ADDIE model in the teaching and rehabilitation of children with autism, in order to provide a reference for researchers and teachers who want to use the model to develop teaching procedures in the future.

## 2. Methodology

### 2.1 Research Design

This review is based on the principles of Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) (Page et al., 2021) The review process, precise inclusion and exclusion criteria, and search plan were developed based on this principle. Articles published between 2010 and 2024 were considered for this evaluation, in order to cover the most recent research on the use of the ADDIE model in the teaching and rehabilitation of children with autism over the past fifteen years.

**2.2 Scope of the Review and Inclusion Criteria**

This review explores the use of the ADDIE model in the teaching and rehabilitation of children with autism and the changing trends in its use. As such, only literature published in the last 15 years (2010-2024) was considered. Having made a decision to limit the literature review in this way, according to the results of the search, it became apparent that existing studies had mainly been carried out during this time period, and the amount of literature before 2010 was very small or no relevant literature could be retrieved. The following inclusion criteria were used to select literature for this review: (a) studies had to have been published in peer-reviewed journals or conference papers and dissertations (due to the small number of relevant studies and Drott's (1995) view that conference papers, as precursors to journal papers, have an important role in scholarly communication, conference papers and dissertations were also included as literature to be analyzed); (b) the subject of the study had to be children with autism; (c) the literature had to be focused on the instructional design and development of all aspects of teaching and rehabilitation of children with autism using the ADDIE model; (d) the written text had to be in English. Also, studies were excluded if they: (a) were not related to or did not include children with autism; (b) were not written in English; (c) were not conducted using the ADDIE model; (d) examined topics or variables that did not fall within the field of teaching and rehabilitation of children with autism.

**2.3 Search Strategy**

In this review, the literature search process was conducted on Web of Science (WoS) (https://apps.webofknowledge.com/), Google Scholar (https://scholar.google.com/) and CNKI (https://www. cnki.net/index/) using "Children with autism", "ASD", "ADDIE model" and "addie model" as keywords for the combined search. The reason for choosing these three databases is that they all have the advantage of being comprehensive and of high quality; WoS and Google Scholar can provide a comprehensive understanding of research in many countries around the world, and CNKI can provide a clear understanding of research in China.

**2.4 Study Selection**

The final literature included in this review was determined by the researcher and two postgraduate students in special education. Firstly, the researcher conducted a literature search in WoS, Google Scholar and CNKI using keywords and read the titles, abstracts, and keywords of the retrieved literature to initially identify the literature that was highly relevant to the topic of the study and eliminate the literature that was not relevant to the topic. Secondly, the retained literature was imported into Endnote 20, and the full text was read; in particular, the findings of the papers were analyzed, and literature that did not meet the inclusion requirements, such as review articles, was excluded. Finally, the retained literature was subjected to a final screening process, in which duplicate items were removed. After the above work was completed, the results were reviewed by two postgraduate students to ensure that the retained literature fully met the requirements of the review, and the literature that could be reviewed was finally identified.

Out of 2,210 studies retrieved, 2,084 (94.3%) were excluded after reviewing the titles and abstracts due to irrelevance: 964 (43.6%) were unrelated to autism, 31 (1.4%) were not in English, 537 (24.3%) did not use the ADDIE model, 552 (24.9%) were not in the field of teaching and rehabilitation, and a total of 126 were retained. Ninety of the 126 studies were excluded after reading the full paper: 83 (65.9%) were of low relevance to the topic and unclear content, 7 (5.6%) were duplicated. After the procedure, a total of 36 pieces of literature were finally left that met the theme and requirements of this review. Figure 1 shows the research selection process.

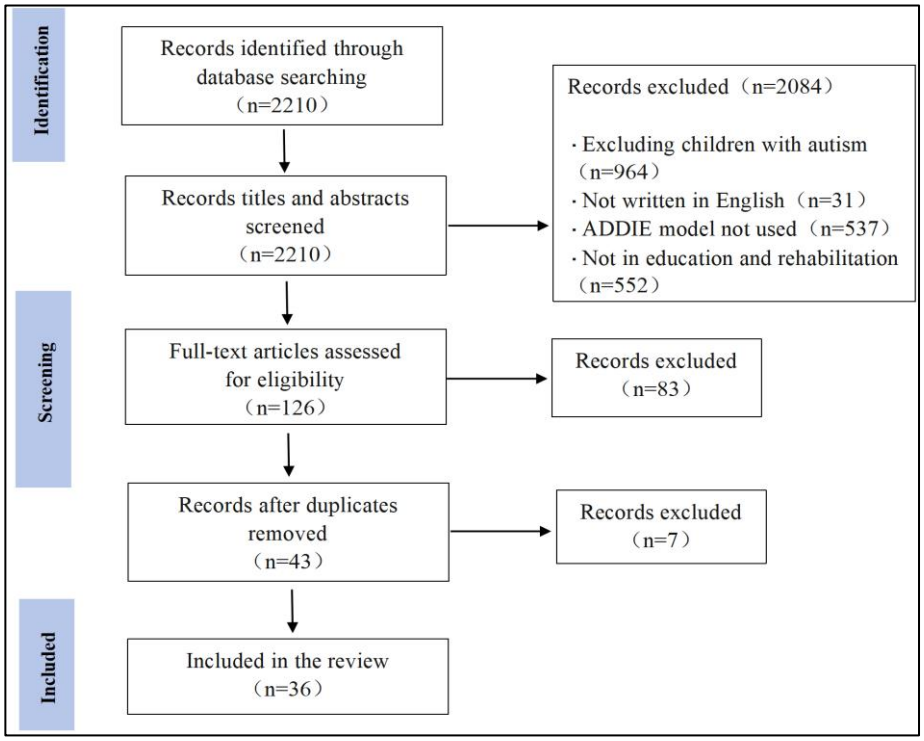


**Figure 1: Study selection process**

### 2.5 Data items and analysis

Information was extracted from the 36 retained papers, mainly related to the authors of the paper and year of publication, the country, the topic of the program or course devised based on the ADDIE model, the research method, the data collection, the sample, the main field of teaching or rehabilitation, and the main findings of the study. The above information was extracted and listed to facilitate an overall understanding of the use of the ADDIE model in the teaching and rehabilitation of children with autism. Table 1 presents information on the studies conducted on the education and rehabilitation of children with autism based on the ADDIE model (see Appendix 1).

## 3. Findings

### 3.1 Characteristics of the Selected Articles

In order to understand the application of the ADDIE model in the teaching and rehabilitation of children with autism, as well as the trends in related studies, this section firstly provides a visual analysis of the annual distribution of studies, the

distribution of countries, the types of studies, the research methodologies used, the tools used for data collection, as well as the topics involved in the studies, so as to facilitate the understanding of the relevant studies from a holistic point of view.

3.1.1 *Annual distribution of studies*

The distribution of studies by year is shown in Figure 2. From the figure, it can be seen that most of the studies were published in 2023 ($n$=9), five studies were published in 2021 and 2022 each, and four studies were published in 2017, 2019 and 2020, each. Only two were published in 2024 (as of March). Only one was published in 2012, 2015 and 2018. There were no relevant studies published in years 2010 and 2011. The trend line in the figure shows that the general trend for the number of published studies is on the rise, indicating that research on the application of the ADDIE model in the teaching and rehabilitation of children with autism has been gradually gaining attention.

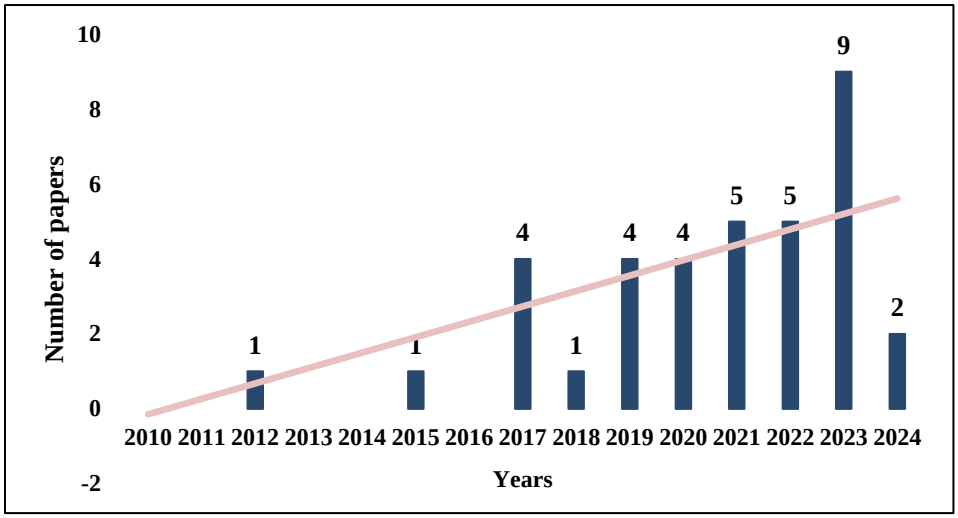


**Figure 2: Annual distribution of papers**

3.1.2 *Countries where the studies were carried out*

Malaysia and Indonesia ranked first in terms of studies using the ADDIE model in the teaching and rehabilitation of children with autism, with 16 publications each. Germany had two studies, while the USA and the Philippines had only one study each, and no other countries were represented by relevant literature. The reason for the predominance of literature in two countries, Malaysia and Indonesia, may be related to the fact that the ADDIE model has not been widely disseminated in the field of children with autism nationwide. Secondly, most of the studies in these two countries are based on the DDR research methodology, which aims to design and develop enrichment content for the target audience or educators, and the ADDIE model has been widely utilized as an important instructional design model in DDR. Figure 3 illustrates the spread of studies across countries.

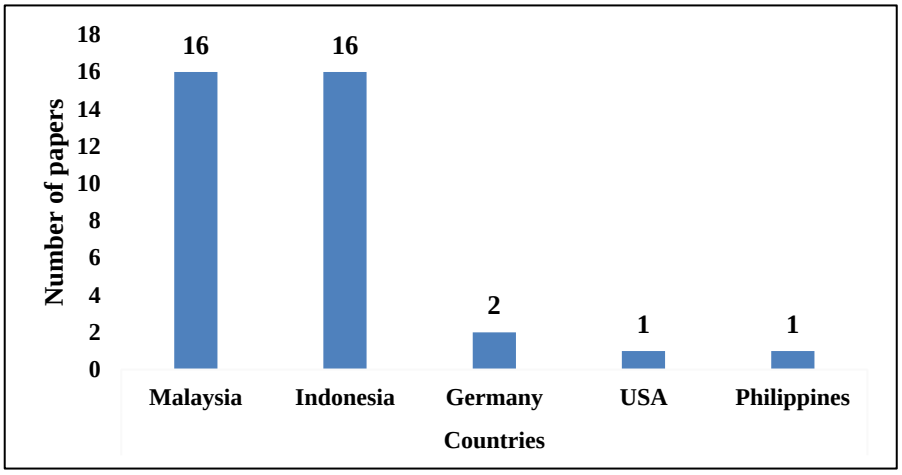


**Figure 3: Countries where studies were conducted (in descending order of number of publications)**

3.1.3 *Distribution of study types*

Most of the studies were published in journals (*n*=20, 55.56%) such as the *Journal of Education for Sustainability and Diversity*, *International Conference Information Visualization and Behaviour Analysis in Practice*, etc. This was followed by conference studies (*n*=13, 36.11%) such as the International Conference on Education and Social Science Research (ICESRE) and International Conference on Sports Science and Health (ICSSH 2022), among others. Finally, there were theses (*n*=3, 8.33%), which mainly consisted of two postgraduate theses and one bachelor's degree thesis. Figure 4 indicates the distribution of the studies according to publication type.

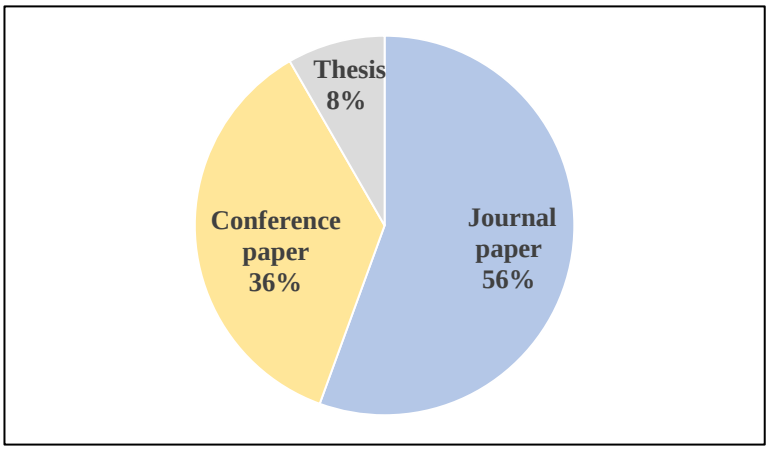


**Figure 4: Distribution of paper types**

3.1.4 *Examination of studies by research method*

The research methods used in the studies are shown in Figure 5. Quantitative research methods were preferred (*n*=24), followed by qualitative research methods (*n*=6), mixed research methods (*n*=4) and literature review (*n*=1).

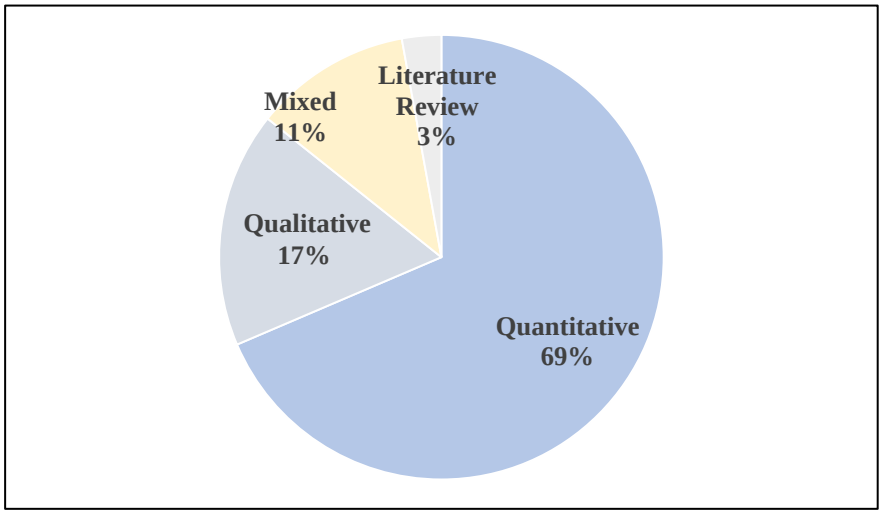


**Figure 5: Distribution of study research methods**

3.1.5 *Data collection tools and methods*

Having considered the research methodologies used, the data collection tools and methods used in the studies were analyzed and Figure 6 shows the statistics for the different data collection tools used in the study. According to the figure the most commonly used tools for data collection were questionnaires (*n*=13); interviews (*n*=9); other tests (e.g., pre- and post-tests or tests that were not explicitly stated) (*n*=8); observations (*n*=6); experiments (*n*=4) and other methods such as picture collection (*n*=2).

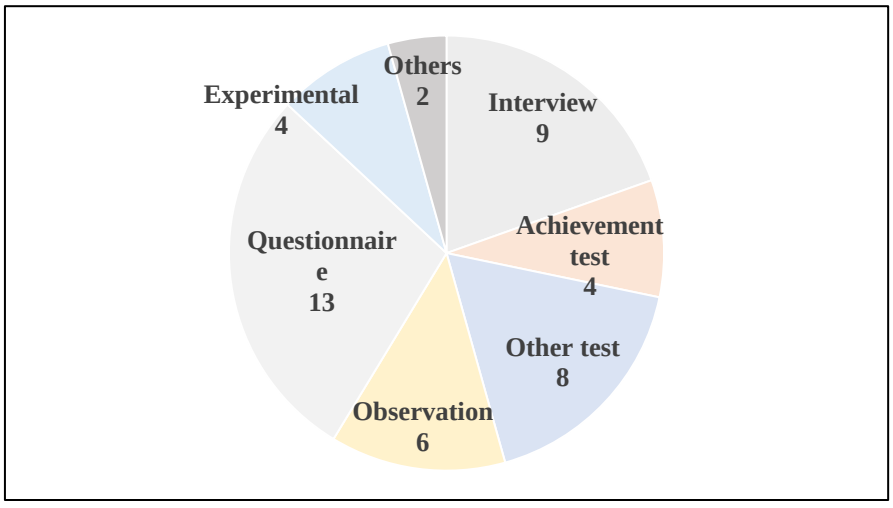


**Figure 6: Distribution of the data collection tools used in the studies**

3.1.6 *Research topics*

The research topics in this section refer to the main areas and themes of teaching and rehabilitation for children with autism, i.e., the areas in which the ADDIE model was applied to teaching or rehabilitation. Figure 7 illustrates the distribution of the different topics in which the ADDIE model was applied to the teaching and rehabilitation of children with autism across the studies.

Firstly, it was most frequently applied to the social communication and interaction of children with autism (*n*=10, 27.78%). Secondly, it was used for tasks related to cognitive aspects of development (*n*=7, 19.44%), which mainly included math learning and numeracy. Five studies analyzed how it was applied to language expression and learning skills of children with autism (*n*=5, 13.89%). There were four studies relating to ADDIE and motor skills (11.11%), three each for self-care skills (8.33%) and perceptual (8.33%) instruction, and only one study related to interventions for problem behavior (2.78%). There were also three studies applied to other areas (8.33 %), such as interest in learning.

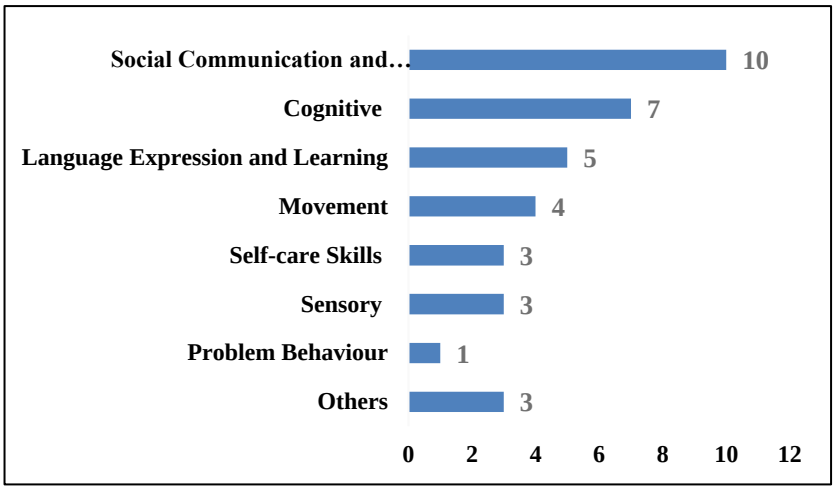


**Figure 7: Distribution of teaching and rehabilitation topic**

### 3.2 Application of the ADDIE Model to the Teaching and Rehabilitation of Children with Autism

Appendix 1 lists 36 studies on the application of the ADDIE model to the teaching and rehabilitation of children with autism (in order of research topic). To facilitate an understanding of the status and effectiveness of the application of the ADDIE model in different domains, the topics were categorized into social communication and interaction, cognitive, language expression and learning, movement, self-care skills, sensory, problem behaviors, and others.

#### 3.2.1 *Social communication and interaction*

In order to improve the quality of life of children with autism, Amran (2012) argued that being able to respond and socialize appropriately in different settings is crucial, and he used the ADDIE model to develop an application called VIMAS for 8-12-year-old children with autism, which related to four main venues, to teach them to complete tasks. After teaching, the app and modeling were found to be reliable and beneficial to the sample in terms of improving their quality of life.

Mohd, Shahbodin, Maria et al. (2019) concluded that videos can be effective in improving the social activities of children with autism; so, based on the ADDIE model, videos were developed for teaching children with autism. During the process the researchers found that children with autism were more attentive. Azizah et al. (2021) used the ADDIE model and eye tracking to design a

framework called Tracking for Autism (TFA), an interactive game for children with autism. After using it, it was found that the children with autism improved in terms of their ability to observe objects and look down with their eyes, and it was confirmed that the interactive game could improve the children's levels of interaction.

Az-Zahra et al. (2023) developed a program called Sorari to improve effective communication and promote social inclusion among children with autism, and found that the program was successful in improving their communication skills. In the same year, Ibrahim et al. (2023) developed an application called Multimedia Interactive Social Skills Module (MISSM) for 15 children with autism aged 4-12 years, to improve their social skills. They received a range of support and positive feedback.

In addition to the above, some researchers have focused on the assessment of social interaction skills of children with autism and developed an assessment tool based on the ADDIE model for children with autism aged 5-6 years old, which has been tested and found to be effective in understanding the level of social interaction with reliability (Ismawati et al., 2023). Isniawati et al. (2023) continued to consider the importance of teaching social interaction to children with autism by developing a social media story for them based on the android system and assessing the reasonableness of the story through experts and received a rating of 84.6% versus 77.8%.

Wardani et al. (2023) also focused on the interactive skills of children with autism and used a board game to teach them. After teaching, it was found that the board game could improve the interactive skills of eight cases and their level of communication with classmates. In the follow-up, the researchers concluded that the board game should be adjusted to take into account the individual variability of the children. Wulandari et al. (2024) developed video modeling media to improve the social skills of children with autism, which was evaluated and found to have a high level of support (all achieved ratings of over 80%), proving that it had a good effect. Ningrum (2024) developed a program to improve the social skills of children with autism, which received good evaluation results and can be used to improve the children's social skills by improving their vocabulary, and encouraging them to exercise eye contact and response skills together to improve social skills.

From the above 10 studies on social interaction and communication in children with autism, we can see that since 2023, there has been a significant focus on applying the ADDIE model to teaching social interaction skills in children with autism, and the results of these studies have been rich. Several studies have been conducted on teaching and rehabilitating the social communication skills of children with autism using a variety of techniques, including applications, assessment tools, and media stories, and positive results have been obtained.

3.2.2 *Cognitive*

There was also an abundance of research applying the ADDIE model to the cognitive aspects of the development of children with autism, most notably mainly in the areas of math and numeracy. Aziz et al. (2015) found that in addition to core areas of difficulty, such as social interaction, children with autism had lower math skills, so they developed a mobile math app based on the ADDIE model, which recognized objects through simple math, identifying object shapes and sizes to improve math. The evaluation concluded that the app was effective.

Thani and Ramli (2019) designed a visual counting book based on the ADDIE model, which is a traditional paper version of the book used to improve children's counting skills, and it was found to be effective in improving the counting skills of children with autism after an experiment involving 15 children. Elshahawy et al. (2020) developed a game based on the ADDIE model with the aim of improving the computational thinking and programming skills of children with autism. The game was found to be effective in improving their counting and programming skills.

Mohd, Shahbodin, Noor et al. (2020) identified a role for games for children with autism and developed a game program to help them learn simple mathematics. The results of a survey with five respondents pointed to the efficacy of the method and confirmed that it motivated the children to learn mathematics. Purnapasha et al. (2022) developed a bowling game to promote early mathematical and logical development in children with autism and found that the bowling game was effective in the development of early mathematical and logical intelligence. Elshahawy et al. (2022) found that there was a lack of research on the computational thinking of children with autism, so they developed a game platform to improve computational thinking and problem-solving skills in children with autism and found that it was effective in motivating them to learn math. Additionally, the game platform was able to improve children's computational thinking and problem-solving skills.

In addition to knowledge about math, Kurniasari et al. (2021) argued that adaptability to school and cognitive skills in general are also important, and they developed a product called Universal Design for Learning (UDL) based on the ADDIE model. They conducted a study with 10 children with autism, and found that the product was effective; it was a feasible tool and effective in improving the adaptability and cognition of children with autism.

Based on the above studies on the cognitive development of children with autism, most of the studies focused on the mathematical skills of children with autism, with some researchers considering other cognitive skills to a lesser extent. There was a lack of research related to cognitive abilities other than mathematical ability and logic. In terms of the available research, the teaching materials and procedures developed for the cognitive development of children with autism based on ADDIE had good results.

3.2.3 *Language expression and learning*

In terms of language expression skills, Suistika and Ishartiwi (2019) developed a picture book for children with autism based on the ADDIE model, which included text and rich pictures, and the study found that the picture book was beneficial for improving the language expression skills of children with autism. In terms of language learning, Mohamad and Ariffin (2017) developed an English learning module for children with autism, which mainly included learning content such as animals and numbers to help Grade 1 children with autism learn English vocabulary. The study was considered a pioneering effort in curriculum development for them. Hashim et al. (2021) developed a program called "AReal-Vocab" application and found that the use of the application was effective in improving the English vocabulary learning skills of a child with autism.

Wahab et al. (2023) developed an application called "ThinkAloud" to help children with autism in Malaysia master English. After teaching 10 children with autism, it was found that this app could help and stimulate them to improve their English. In addition to English, Pertiwi et al. (2023) developed a smart board based on the ADDIE model for learning Indonesian for Grade 2 children with autism, and it was found that the smart board was very effective in supporting Indonesian language learning in the classroom. In summary, research on the use of the ADDIE model for language expression and language learning in children with autism is relatively mature, and it has been found to be effective in language expression as well as in the learning of both English and Indonesian in children with autism.

3.2.4 *Movement*

Magno (2021), in his study, developed an assessment tool for gross motor skills in children with autism based on the ADDIE model. Expert evaluation found the assessment tool to be reliable. Kurniawan, Heynoek and Wijaya (2022) developed teaching modules aimed at teaching static dominant movements to children with autism and the results were found to be favorable. In the same year, Kurniawan, Mu'arifin et al. (2022) developed a new teaching module aimed at teaching dynamic balance movements to children with autism, which was found to be effective after being used with Grade 3 children with autism. Given that the teaching module based on the ADDIE model was effective for static dominant and dynamic balance movements, Kurniawan, Noviardah et al. (2022) developed a teaching module for manipulative movement training in children with autism and found that it was effective in improving manipulative movement in children with autism in Grade 4. From the above studies of the ADDIE model in relation to movement skills for children with autism, the developed teaching modules and assessment tools were shown to be effective. Research on the ADDIE model for movement among children with autism has only been studied within the last three years.

3.2.5 *Self-care skills*

Kurniawan et al. (2018) found that children with autism may be unable to take themselves to the toilet independently and this can be troublesome in their lives. Therefore, they developed a video game for children with autism based on the

ADDIE model where the children learn how to go to the toilet on their own. The results showed a good effect in terms of improving children's skills to address this problem. Maria and Shahbodinb (2019) developed an app called "CSBake" specifically to teach baking to children with autism and found it easy to use after using it to teach five children with autism aged 13-15 years old. Ardianingsih et al. (2023) developed a video game to improve the ability of children with autism to organize their personal hygiene, which was found to be highly feasible. In terms of the application of the ADDIE model to the abovementioned self-care skills of children with autism, there are currently a few studies available indicating good results in improving toileting, baking and organizing personal hygiene in children with autism.

3.2.6 *Sensory*

Mohd, Shahbodin, Jano, and Azni (2019) found that some children with autism have visual perception problems and there is a lack of relevant diagnostic tools. They developed a diagnostic tool for assessing visual perception problems based on the ADDIE model and found that the tool could be used for the diagnosis and identification of visual problems in children with autism. In the same year, some researchers also carried out the development of related diagnostic tools and concluded that the diagnostic tools developed based on the ADDIE model can be a good way to understand the visual challenges faced by children with autism (Noor et al., 2017). Mohd, Shahbodin, Noor et al. (2022) continued research into the visual disorders of children with autism and developed a game program based on the Android system, which was used in the assessment of 10 children with visual problems; it was found that the program had a favorable impact. From the above research on the application of the ADDIE model to the sensory perception of children with autism, it was found that the current research basically focuses on the study of visual problems in children with autism and lacks any exploration of other sensory perceptions. The findings of the existing studies have shown favorable results.

3.2.7 *Problem behavior*

Sha'arani and Tahar (2017) found that children with autism often have problematic behaviors including tantrums. To improve this problem, the researcher developed social stories based on the ADDIE model and taught them to one child with autism. The study found that social stories can improve the child's tantrums and in a sense, can eliminate this problematic behavior completely. Little research has been done on the use of procedures or materials developed from the ADDIE model with problem behaviors in children with autism, but the existing research suggests good results.

3.2.8 *Others*

In addition to these clear themes and areas, there are three other studies of some significance. Hassan (2020) believes that interest in learning is an important condition for children with autism to be able to get good teaching and learning results. So, based on the ADDIE model, an interactive mobile phone game was developed to increase the interest of children with autism in learning knowledge in the form of games and get good feedback. Zabidi, Yusof, Sidek and Ghazali (2021)

developed a program called Human-Robot Interaction (HRI) to improve the quality and level of teaching and learning for children with autism and found through their research that the program needed higher standards and more research to improve its replicability and acceptability. LaMarca and LaMarca (2024) developed a comprehensive ABA teaching and learning program for children with autism and stated that the development process was based on the ADDIE model. They asserted that it is important to follow the process and use useful resources in the development process. From the above three studies, it can be concluded that the programs developed based on the ADDIE model show good results in improving the interest in learning and quality of teaching for children with autism.

### 3.3 Critical Analysis

Through the above literature, it can be seen that the ADDIE model is currently being applied to the development of procedures and instruction for children with autism in the areas of social communication and interaction, cognitive development, and language expression and learning, and has been found to be effective. However, the existing research also had the following problems. Firstly, the validity and feasibility of the studies are questionable. The ADDIE model advocates the implementation of the model after development to determine whether it is effective and feasible for further modification and adjustment (Reiser & Dempsey, 2012). There is a lack of implementation experience with the instructional materials that have been designed and developed so far, which leads us to question whether they are indeed effective, and points to the need for real-life scenarios to be implemented after expert review.

Secondly, the number of studies is scarce. From the above, we can find that there is a lack of research on the application of the ADDIE model to teaching and rehabilitation in other domains besides social communication and interaction, cognitive development, and language expression, and the application within the domains is not comprehensive. For example, in the sensory domain, existing research basically focuses on the visual impairments of children with autism, whereas children with autism also have problems with sensory integration and other symptoms (Abdel Ghafar et al., 2022). Thus, more research is needed to fill the gap.

Finally, there is a lack of validation in the existing literature, and validation studies are generally required to validate or confirm in the findings of previous studies, thereby increasing the reliability and accuracy of the research. The reliability of the abovementioned instructional materials or procedures based on the ADDIE model could be validated by applying them to different cases. This could improve the reliability of the instructional materials for future reference and use by instructors and researchers.

## 4. Discussion

A total of 36 studies were included in this review with the aim of understanding the trends and specifics of the use of the ADDIE model in the teaching and rehabilitation of children with autism. In terms of study characteristics, and in

terms of study time, the existing studies were mainly focused on 2019-2023, with the highest number of studies (n=9) conducted in 2023. Overall, there has been an upward trend in the number of studies over time, which may be related to the level of understanding of the ADDIE model among researchers and teachers and the importance placed on teaching and rehabilitating children with autism. In terms of country distribution, studies on the use of the ADDIE model in teaching and rehabilitating children with autism were mainly concentrated in Malaysia and Indonesia, with two studies in Germany, and one study each in the United States, and the Philippines. Other than that, there was a lack of research in China and other European countries. The researcher, being Chinese, is aware that the ADDIE model is less well known in China, which may be one of the reasons for the lack of relevant studies. In terms of the type of research, most of the studies were reported in journal papers (n=20), followed by conference papers (36%). Drott (1995) believes that conference papers are the forerunner of journal papers, and that they are important for academic communication, so this study also includes conference papers in the analyzed literature after comprehensive consideration. In terms of the type of literature available, this review indicates that the maturity of the relevant research is low and the number of peer-reviewed journal papers is still lacking compared to other fields.

In terms of research methodology, most of the studies followed a quantitative approach (69%), and researchers believe that the method of quantitative research had more intuitive results by reflecting the situation of the needs of the respondents as well as implementation through data (Noor et al., 2017; Kurniawan et al., 2018). In addition to this, most researchers also believe that qualitative research can reflect the needs and attitudes of respondents in more detail through text (Az-Zahra et al., 2023). Mixed research had also been utilized and combining quantitative and qualitative research can lead to richer findings. In terms of data collection tools, questionnaires and interviews are still the most common methods and tools used to collect data, while experiments and quizzes can also be used as a more intuitive way of obtaining research results.

The range of studies indicated that the ADDIE model had been used in several areas of teaching and rehabilitation for children with autism. The most used area was in helping children with autism to improve their social communication and interaction skills (Amran, 2012; Ibrahim et al., 2023). Secondly, the studies focused on ADDIE's use in cognitive skills development for children with autism, which mainly focuses on the teaching of mathematics (Thani & Ramli, 2019) and logical thinking (Purnapasha et al., 2022). In the area of language expression and learning, the main application was shown to be in the learning of language expression skills (Suistika & Ishartiwi, 2019) and English (Hashim et al., 2021; Mohamad and Ariffin, 2017) and Indonesian (Pertiwi et al., 2023) for children with autism. In the area of movement for children with autism, the studies mainly looked at the assessment of motor ability (Magno, 2021) and rehabilitation (Kurniawan, Heynoek and Wijaya, 2022). In the area of self-care, the main focus was on teaching children with autism to use the toilet independently (Kurniawan et al., 2018), bake (Maria & Shahbodinb, 2019), and maintain good personal hygiene (Ardianingsih et al., 2023). In the perceptual domain, the focus was on the rehabilitation of visual

abilities (Mohd, Shahbodin, Noor et al., 2020) in children with autism. Similarly, the ADDIE model had been applied to develop procedures to help children with autism reduce problem behaviors such as tantrums (Noriah, 2017). In addition to the main areas mentioned above, based on the ADDIE model, it was also apparent that it is possible to develop procedures and materials for improving the interest in learning (Hassan, 2020), and the quality of teaching (Hassan et al., 2021) for children with autism.

These findings are similar to those of previous studies by Ghanih and Daud (2018), and Jonnalagadda et al. (2022), which concluded that teaching based on the ADDIE model can positively affect individual skills and competencies, despite the different study populations. The positive results of these studies are due to the strengths of ADDIE itself (Reiser & Dempsey, 2012); they enable the model's success by allowing the full range of the background science and rationale behind the instructional materials developed through a rigorous research phase and process to be captured.

## 5. Conclusion

Given the lack of a systematic review of research on the use of the ADDIE model in the teaching and rehabilitation of children with autism, this study has filled a gap in knowledge. The following conclusions were drawn from the study. In terms of research characteristics, the relevant studies were mainly focused around 2023, and studies had mostly taken place in Malaysia and Indonesia. The types of research papers were predominantly journal papers and conference papers. Researchers usually used quantitative research and qualitative as the main research methods and obtained information mainly through questionnaires and interviews. Based on the ADDIE model, the studies indicated that it is possible to develop teaching and rehabilitation materials for children with autism in a variety of skill areas (social communication and interaction, cognitive development language expression, movement, etc.), and these teaching materials had good results. In conclusion, the ADDIE model had been utilized in the teaching and rehabilitation of children with autism in a favorable manner. The results of the study could be used as a reference for future researchers and pedagogues in related fields to improved the used of the ADDIE model in the field of teaching and rehabilitation for children with autism, and to improve the quality and level of teaching and learning for children with autism.

## 6. Limitations of the Current Review

This review inevitably had certain limitations and shortcomings. Firstly, in terms of literature search databases, WoS, Google Scholar and CNKI were selected for this review, ignoring relevant studies that may exist in other databases. Based on these three databases this study only included 36 studies for analysis, a small number of studies which may have led to bias in the nature of the studies selected. Secondly, in terms of the time period covered by the literature search, this review limited the search time to the last 15 years, i.e., 2010-2024 March, to understand the most up-to-date situation. Relevant studies before that are not mentioned in this review. Finally, when analyzing the instructional materials developed based on the ADDIE model, this review only deals with thematic aspects and does not

further elaborate on the features, strengths and weaknesses of the instructional materials. These limitations may result in a lack of information for prospective researchers and pedagogues, and do not guarantee a full understanding of the article. The above limitations may perhaps be an issue to be considered and further investigated in future related studies.

## 7. Implications for Future Research

The literature in this review demonstrates that a variety of procedures and materials can be developed for the teaching and rehabilitation of children with autism based on the ADDIE model, and all of them have good results and feasibility. Future research could, firstly, refer to the findings of existing studies and increase the development of teaching materials based on the ADDIE model for the teaching and rehabilitation of children with autism in other areas, in areas such as emotional problems, problem behaviors, and narrow interests of children with autism.

Secondly, on the basis of the existing studies, future research could focus on using teaching materials developed in the existing studies to teach other children with autism to test the reasonableness of the existing teaching materials. This may improve the replicability and effectiveness of the teaching materials, and on the other hand could also facilitate the direct use of the teaching staff. Moreover, the existing studies mainly focus on small samples, and an appropriate expansion of the sample size would improve the authoritative credibility of the research results.

Finally, due to the reality of the large individual differences between children with autism, it is recommended that future research designs and the development of corresponding teaching materials based on the ADDIE model, take individual differences into full consideration, and that teaching materials for children with autism are designed in such a way that they are more suitable for the children's individual development. Targeted teaching and rehabilitation would be more conducive to the children's development and enhancement. The ADDIE model, with its inherent flexibility, can be adjusted according to the real situation and the developmental level of each child with autism.

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**Appendix 1: Summary of Studies Using ADDIE Model in the Teaching and Rehabilitation of Children with Autism**

| Author (date) | Country | Programs or course topics (Based on ADDIE model) | Research method | Data collection | Samp-ling (n) | Fields of teaching and rehabilitation (Variable) | Main research findings | Suggestions for future research |
|---|---|---|---|---|---|---|---|---|
| Amran (2012) | Malaysia | Video Molding（VM） | Mixed | Interview& questionnaire | ASD Aged 7-8 years | Appropriate activities in the community | The model is reliable and improves the community activities of children with autism. | Other OS development, adding functionality, VR technology. |
| Mohd, Shahbodin, Maria et al. (2019) | Malaysia | Video Development | Quantitative | Questionnaire | ASD | Social activities | Subjects are more satisfied and are able to increase their level of social activity. | Provide effective guidance for the material and validate it. |
| Azizah et al. (2021) | Indonesia | Interactive games based on eye tracking | Quantitative | Experimental & Achievement test | ASD | Interactivity | Children with autism have improved their ability to interact and the number of interactions has increased. | _ |
| Az-Zahra et al. (2023) | Indonesia | Sorari Programmes Visual Animation | Qualitative | Verbally describe | HFA | Communication challenges | The programme was very successful. | _ |
| Ibrahim et al. (2023) | Malaysia | Multimedia Interactive Social Skills | Quantitative | Pre post test | ASD 4-12 years (15) | Social skills | Can help children with autism learn social skills. | Expanding the sample and observing the |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Module Application | | | | | | effects through videotaping. |
| Ismawati et al. (2023) | Indonesia | Interpersonal Intelligence Assessment Instruments | Quantitative | Test | ASD (3) | Interpersonal skills | Assessment tools are valid and reliable. | _ |
| Isniawati et al. (2023) | Indonesia | Social Media Stories | Quantitative | Questionnaire | ASD | Social behaviours | Social media stories are feasible and effective. | Researchers add activities related to social behavior. |
| Wardani et al. (2023) | Indonesia | Board Game | Qualitative | Interview & Observation | ASD Aged 8-12 years (8) | Interactivity | It enhances student interaction and it helps students to communicate with their peers. | Consider the individual characteristics and needs of children with autism. |
| Wulandari et al. (2024) | Indonesia | Web-Based Video Modelling Media | Quantitative | Questionnaire | ASD (3) | Social skills | Great results for social skills in children with autism. | Develop web based video modelling with behavioral. |
| Ningrum (2024) | Indonesia | Programs | Qualitative | Interview & Observation | ASD | Communication skills | Improve communication skills by improving vocabulary and working on eye contact and reflexes. | _ |
| Aziz et al. (2015) | Malaysia | Mobile Numerical Apps | Mixed | Interview& attitude test | ASD | Numerical and mathematical skills | Apps are great for learning maths for children with autism. | _ |
| Thani and Ramli (2019) | Malaysia | Visual Counting Book | Quantitative | Test | ASD (15) | Counting ability | Practical and effective to stimulate students' | Conduct thorough testing to |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | (10 boys, 5 girls) | | learning and improve concentration. | determine practicality. |
| Elshahawy et al. (2020) | Germany | Serious Game | Quantitative | Engagement test | ASD Aged 7-14 years (8) | Computational thinking and programming | Effective children with autism improve numeracy and programming skills. | Set up more functions and extend the intervention time. |
| Mohd, Shahbodin, Sedek, and Samsudin (2020) | Malaysia | Game | Quantitative | Experimental | ASD Aged 5-18 years | Simple math | Engaging and motivating children to learn is considered effective. | _ |
| Purnapasha et al. (2022) | Indonesia | Bowling Game | Quantitative | Questionnaire & Achievement test | ASD Aged 5 years | Mathematical logical intelligence | Effective and practical for early mathematical and logical intellectual development. | Develop games for more children and more types of special needs children. |
| Elshahawy et al. (2022) | Germany | Serious Game and game platforms | Quantitative | Interview, Questionnaire Achievement test | ASD Aged 10-14 years (6) | Computational thinking and Problem-solving skills | Ability to improve computational thinking and problem solving skills. | Develop more programming methods to address counting skills in socialization. |
| Kurniasari et al. (2021) | Indonesia | Learning Planning Products | Quantitative | Questionnaire | ASD (10) | Adaptive and cognitive abilities | Effective and feasible for improving the adjustment of children with autism. | _ |

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| Suistika and Ishartiwi (2019) | Indonesia | Picture Book Media | Mixed | Interview, observation & questionnaire | ASD | Language expression | Picture books favour the development of expressive language skills in children with autism. | _ |
| Mohamad and Ariffin (2017) | Malaysia | English Learning Module | Qualitative | Case study observation & interview | ASD in grade 1 | English Vocabulary | Considered a pioneering effort in curriculum development for children with autism. | _ |
| Hashim et al. (2021) | Malaysia | "AReal-Vocab" | Qualitative | Interview & Observation | ASD Aged 7 and 10 years (2) | English vocabulary learning | A more meaningful way of learning with good results. | Help parents and teachers solve problems. |
| Wahab et al. (2023) | Malaysia | ThinkAloud Apps | Quantitative | Pre post test | ASD (10) | Mastery of English | Help and stimulate children with autism to improve their English skills. | Expanding the sample size to verify reliability. |
| Pertiwi et al. (2023) | Indonesia | Smart Board Visual Media | Mixed | Interview & Questionnaire | ASD in grade 2 | Indonesian language | Very effective in supporting Indonesian language learning in the classroom as a tool for students to understand the materials. | _ |
| Magno (2021) | Philippines | Gross Motor Assessment Tool | Quantitative | Test | ASD (34) | Gross motor | It is reliable and can adequately assess the level of gross motor development. | Improve and apply |

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| Kurniawan, Heynoek and Wijaya (2022) | Indonesia | Movement Modules | Quantitative | Questionnaire | ASD (9) | Static dominated movement | Effectively improving static dominant movement in children with autism. | Upgrade the model to the next grade level for children. |
| Kurniawan, Mu'arifin et al. (2022) | Indonesia | Movement Modules | Quantitative | Experimental | ASD in grade 3 | Dynamic balance movement | Effectively improving dynamic balance movement in children with autism. | Provide more detailed guidance for teachers and students. |
| Kurniawan, Noviardah et al. (2022) | Indonesia | Movement Modules | Quantitative | Experimental | ASD in grade 4 | Manipulative movement | Effectively improving manipulative movement in children with autism. | Open up more content and expand the sample. |
| Kurniawan et al. (2018) | Indonesia | Computer Game | Quantitative | Experimental | ASD Aged 7-12 years (6) | Self-help toilet learning | Demonstrated positive results. | Expanding the sample size and extending the duration of the intervention. |
| Maria & Shahbodinb (2019) | Malaysia | CSBake | Quantitative | Questionnaire & Observation | ASD Aged 13-15 years (5) | Baking skills | Programs are easy to use and help children with autism learn skills. | Improvements to CSBake. |
| Ardianingsih et al. (2023) | Indonesia | Visual Support Products | Qualitative | Interview | ASD | Personal hygiene | The feasibility is very high. | _ |
| Mohd, Shahbodin, | Malaysia | Game Diagnostic Tool | Literature Review | Literature Review | ASD | Visual perception issues | Can be used to diagnose visual | Using serious game to identify |

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| Jano, and Azni (2019) | | | | | | | perception in children with autism. | visual perception problems. |
| Noor et al. (2017) | Malaysia | Game Programme | Quantitative | Questionnaire | ASD | Visual perception | Can help teachers diagnose children with autism. | _ |
| Mohd, Shahbodin, Noor et al. (2022) | Malaysia | Interactive Mobile Game | Quantitative | Questionnaire | ASD (10) | Visual impairment | Positive impact on visual detection in children with autism. | Consider who to collaborate with. |
| Noriah (2017) | Malaysia | Social Stories | Quantitative Case study | Observation& Achievement test | Aged 18 (1) | Tantrum behaviour | Not only can negative behaviours be reduced, they can be almost completely eliminated. | Innovative animation forms and development of applications. |
| Hassan (2020) | Malaysia | Interactive Mobile Learning Game | Quantitative | Questionnaire | ASD | Ability and interest in learning | This interactive mobile game has usability. | Improved. |
| Zabidi et al. (2021) | Malaysia | Human-Robot Interaction (HRI) | Quantitative | Test | ASD | For teaching | More standardised models are needed to improve replicability and acceptability. | A more standardized model to verify replicability and acceptability. |
| LaMarca and LaMarca (2024) | USA | Programs | / | / | ASD | Comprehensi-ve ABA treatment | Consistent processes to follow, key actions to take, and helpful resources to use when | _ |

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| | | | | | | | developing integrated planning for individuals with autism. | |

Note: The studies are sorted in order of the topic of the study