

Designing a Board Game for Children with Attention Deficit Hyperactivity Disorder: A Quality Function Deployment Approach

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Abstract

Attention Deficit Hyperactivity Disorder (ADHD) is a neurodevelopmental disorder characterized by difficulty sustaining attention and concentration, which can hinder children's learning processes in inclusive educational settings. Based on observations and interviews at an elementary school, it was found that the learning materials and methods used failed to effectively capture the attention of students with ADHD during the learning process. This study aims to design the educational board game "Playtensia of the Jungle" as an interactive learning tool to help improve the concentration of elementary school-aged children with ADHD. The design process was conducted using the Quality Function Deployment (QFD) method to capture user needs into technical product specifications. The research was conducted through field observations, interview with teacher, literature reviews, and expert validation. The design results indicate that the board game was developed with consideration for ergonomic, safety, visual, and sensory stimulation aspects appropriate for children with ADHD, including the use of attractive color elements, letter-arranging activities, and interactive audio features. Based on the results of media expert validation, the board game design was deemed suitable as a supplementary learning tool capable of increasing children's interest and engagement in the learning process. Thus, "Playtensia of the Jungle" has the potential to become an innovative learning tool that can be used both at school and at home to help train the concentration of children with ADHD in a fun and adaptive way.

Keywords

ADHD, educational board games, students' concentration, learning materials, Quality Function Deployment.

1. Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is one of the most common neurodevelopmental disorders in children and is estimated to affect approximately 8% of the global child population, with relatively higher prevalence in North America (Goulet et al. 2026). In Indonesia, ADHD is also quite common. However, there is no definitive national prevalence data available because related research remains limited to specific regions and populations (Wimbarti 2023). Several studies, such as those conducted by Christina et al. (2013), found that the prevalence of ADHD among school-aged children in Yogyakarta, Indonesia, was 5.47% in Cangkringan District (Wimbarti 2023). Another study conducted on children aged 9–12 years by Setyanisa et al. (2022) at five elementary schools in Surabaya, Indonesia, found that the prevalence of ADHD reached 55 out of 449 children (12.2%) (Rabitho and Setiawati 2024). Another study with similar results was conducted by Setiawati et al. (2024), which found that of the 120 children examined, 13.3% were considered at risk for ADHD (Setiawati et al. 2024).

ADHD is diagnosed nearly twice as often in boys as in girls and is characterized by persistent difficulties in sustaining attention, controlling impulses, and regulating activity levels (Goulet et al. 2026). This condition directly impacts concentration and self-regulation. Thus, children with ADHD often struggle to complete tasks, maintain focus, wait their turn, follow instructions, and participate fully in learning activities (Goulet et al. 2026). Based on observations conducted by Goulet et al. (2026), it was found that students with ADHD exhibit significant difficulties in maintaining concentration during classroom learning activities. Meanwhile, the learning materials used are still dominated by textbooks and conventional visual aids, which have not been able to provide sufficient stimulation to sustain students' attention over time. As a result, students tend to be easily distracted, lose interest in learning, and show low engagement during the learning process.

In recent years, Game-Based Interventions (GBI) have increasingly been developed as a potential approach to improve cognitive abilities in individuals with ADHD (Mao et al. 2025). GBI is a form of structured intervention that utilizes key elements of game design, such as objectives, rules, feedback or reward systems, game progression, and adjustable difficulty levels (Mao et al. 2025). Unlike conventional cognitive training methods, which tend to be repetitive and unengaging, GBI integrates various game mechanisms such as adaptive challenges, immediate feedback, goal-setting, and reward systems to maintain user engagement throughout the process (Mao et al. 2025). Generally, GBI is often developed in digital formats using devices such as computers, tablets, or gaming consoles. However, this approach can also be applied in non-digital formats, such as board games or movement-based activities (exergames) that combine physical and cognitive elements (Mao et al. 2025). Regardless of its form, GBI shares the same primary objective to enhance specific cognitive functions, such as attention, working memory, and inhibitory control, through interactive, enjoyable, and motivating learning experiences (Mao et al. 2025).

Although various studies have shown the effectiveness of GBI in supporting the improvement of cognitive function and concentration in children with ADHD, similar research in the Indonesian context is still dominated by simple game-based interventions such as puzzles and educational toys (Sandrawati et al. 2019). Research shows that puzzle media can help improve the concentration ability of children with ADHD through a qualitative case study approach (Zahroh et al. 2024). In addition, use of educational play tools can improve the concentration of children with ADHD through the Single Subject Research method (Sandrawati et al. 2019).

Board games are a type of game played using a board, in which players interact by moving or placing pieces according to specific rules on a patterned board surface (Noda et al. 2019). Over time, board games have been used not only for entertainment but also as a learning tool. Research by Noda et al. (2019) indicated that the use of board games in an educational context has a positive impact on knowledge acquisition, with varying levels of effectiveness, ranging from low to high, depending on the game's design and the context of its application. Several previous studies have also highlighted that board games that are specifically designed for educational purposes can foster more active and participatory learning processes (Noda et al. 2019). According to Noda et al. (2019), Board games can create a fun learning environment while enhancing motivation, social interaction, and student engagement in the learning process. In addition, Noda et al. (2019), state that board games support the learning process through interactive and collaborative learning experiences with friends and family. In the context of children with ADHD, Kim et al. (2014) found that board games such as "Go" have the potential to provide cognitive benefits because they can stimulate prefrontal cortex activity and improve executive functions related to attention and self-control (Noda et al. 2019).

Previous research has focused on evaluating the effectiveness of existing game media and has not discussed the development of an innovative educational board game designed systematically based on user needs (Sandrawati et al. 2019). To the best of our knowledge, based on the literature review conducted, there has been no research reporting the application of the Quality Function Deployment (QFD) method in the design of an interactive learning tool for children with ADHD. Therefore, this research was conducted to develop an educational board game based on QFD, specifically designed according to user needs, to improve the concentration of children with ADHD. Given this gap, this study aims to design the educational board game as an interactive learning tool intended to help improve the concentration of children with ADHD in elementary school. The design process implemented the Quality Function Deployment (QFD) method to systematically translate user needs into technical product specifications, ensuring that the resulting design aligns with user needs and the characteristics of the target learning objectives.

1.1 Objectives

This study aims to design an educational board game as an interactive learning tool intended to help improve the concentration of children with Attention Deficit Hyperactivity Disorder (ADHD) in elementary school at Special Education School in Surabaya, Indonesia. Additionally, this study aims to apply the Quality Function Deployment (QFD) method to translate user needs into technical product specifications, resulting in a board game design that aligns with the cognitive, visual, and behavioral characteristics of children with ADHD. The primary contribution of this study lies in the development of a board game-based learning tool systematically designed using a product engineering approach and oriented toward the specific needs of users within the context of inclusive education.

2. Literature Review

2.1 Attention Deficit Hyperactivity Disorder (ADHD)

Attention Deficit Hyperactivity Disorder (ADHD) is one of the common mental disorders in children and can continue into adulthood (Natarezwa et al. 2023). Children with ADHD generally have difficulty sitting still, appear restless, often interrupt conversations, struggle to complete tasks, pay little attention when spoken to, and frequently lose items due to low attention (Guazzo and Nappo 2025). In Indonesia, cases of ADHD are quite high, with a prevalence of 26.4% (Putri et al. 2024). Data from the National Central Statistics Agency in 2007 indicate that one in five children and adolescents under the age of 18 experience mental health disorders, including ADHD (Putri et al. 2024). ADHD is classified into three types: predominantly inattentive, characterized by difficulty concentrating without hyperactivity; predominantly hyperactive/impulsive, marked by very active and impulsive behavior; and the combined type, which shows both symptoms simultaneously (Silitonga et al. 2023). The exact cause of ADHD is not yet known, but it is suspected to be influenced by genetic factors, gene mutations, premature birth, exposure to alcohol and tobacco during pregnancy, lead exposure, and brain damage before birth that can affect the development of the central nervous system (Magdalena et al. 2024).

2.2 Educational Intervention for ADHD: Puzzles and Board Games

Various educational interventions have been developed to support children with ADHD, including puzzle-based learning activities. Research by Andriza and Mahdi (2022) shows that puzzle games can improve attention in children with ADHD through activities that require sustained visual focus and concentration. This medium has advantages in training attention, concentration, and problem-solving skills. However, the learning activities offered are still limited to puzzle assembly, resulting in relatively low variation in learning interactions. Additionally, the study employed a Single Subject Research (SSR) approach with a single participant, so the results have limitations in representing the needs of a broader user population. A study by Sholichah and Hasanah (2023) combined play therapy with animal-themed puzzles for children with ADHD. The results showed a reduction in ADHD symptoms and an improvement in concentration following the intervention. The approach effectively combines cognitive exercises with play-based activities, promoting active participation and sustained engagement among children. However, the intervention remains focused on puzzle-based tasks, providing limited support for broader learning aspects such as language development, social interaction, and multisensory stimulation. Moreover, the study primarily evaluates the effectiveness of the intervention and does not employ a user-centered design approach to identify and translate user needs into product development requirements.

Board games use a wide flat surface for interactive gameplay (Ningtyas 2023). Board games are technically defined through systematic rules and the use of physical components such as tokens and pieces that can be manipulated on the board (Putri et al. 2024). The dynamics of this game create an effective learning ecosystem because it can integrate cognitive activities with aspects of communication and reasoning through recreational play activities (Maryanti et al.

2021). In addition, board games can also hone critical thinking, creativity, and strategic planning skills in problem-solving (Fadli et al. 2025). This media also plays an important role in boosting students' self-esteem because by focusing on the goal of winning, students can naturally reduce psychological barriers, such as fear of judgment or pressure regarding learning materials (Hashim et al. 2024).

According to research by Andriza and Mahdi (2022), puzzle activities are effective in training visual focus and sustained attention. Meanwhile, research by Sholichah and Hasanah (2023) shows that combining puzzles with animal themes and play activities can increase children's engagement during the learning process. However, both of these approaches still focus primarily on puzzle solving activities, so the variety of learning interactions offered remains limited. Therefore, there is an opportunity to develop boardgame based learning media that retains the strengths of puzzles in training concentration, adopts animal themes that appeal to children, and adds elements of social interaction, game exploration, problem solving, and multisensory stimulation through a combination of visual, kinesthetic, and auditory activities.

2.3 Quality Function Deployment

Quality Function Deployment (QFD) is a structured method in product planning and development that focuses on translating customer needs and desires into product technical specifications (Nurochim et al. 2021). This method was first introduced by Dr. Yoji Akao in Japan in the late 1960s as a systematic approach to producing products that meet customer expectations (Lilianti 2024). In its application, QFD is developed through four main stages, namely product planning, design planning, process planning, and production planning (Cohen 1995). These four stages allow customer needs to be gradually translated from the user needs level to the production aspects.

One of the main tools in the implementation of QFD is the House of Quality (HOQ), which is a house-shaped matrix used to map the relationship between customer needs and the technical characteristics of the product (Ngurah Priambadi et al. 2024). Through the HOQ, the product design process can be carried out in a more systematic, directed, and measurable manner, thereby helping to minimize design errors and improve product alignment with user needs (Rengganis et al. 2025). Various studies also show that the application of QFD can improve the efficiency of the design process, reduce design changes at the final stages of development, and enhance the quality of the resulting products (Suhartini et al. 2026). Therefore, QFD is widely used as a product development approach oriented toward customer satisfaction.

Various studies show that board games have the potential to enhance cognitive function, attention, and social interaction in children with ADHD through interactive and experiential learning mechanisms (Noda et al. 2019). Educational puzzle media have also proven effective in supporting attention and focus in children with ADHD Wimbari (2023), while educational board games generally have the potential to increase student motivation and learning outcomes (Rabitho and Setiawati, 2024). Moreover, game-based interventions have been reported to support cognitive function improvement in children with ADHD (Noda et al. 2019). In the context of product design, Quality Function Deployment (QFD) is a method that focuses on user needs (voice of customer) and is capable of translating those needs into systematic and measurable design specifications Gündüz (2016), supported by the House of Quality (HoQ) as a tool for mapping user needs to technical design attributes (Cropley 2021). However, the implementation of QFD approach in the development of educational board games specifically designed to support the concentration of children with ADHD has not yet been extensively explored in previous research, particularly in the context of developing interactive learning media at the elementary school level.

3. Methods

This study was conducted in Surabaya, Indonesia. The object of this study was an inclusive elementary school in Surabaya.

3.1 Population and sample

This research uses a product design approach with the Quality Function Deployment (QFD) method to develop an educational board game for children with Attention Deficit Hyperactivity Disorder (ADHD). This research was conducted at one of the special schools in Surabaya. The research population includes students with a diagnosis or indication of ADHD at the elementary school level in that school. The students with ADHD participate in learning activities with the assistance of special education teachers.

User needs for the development of the House of Quality (HOQ) were gathered through an interview with teacher who directly supported the two students with ADHD in the class. The teacher was selected because they possessed the most relevant knowledge and experience regarding the students' learning behaviors, characteristics, and educational needs.

The limited number of samples is deemed adequate because this research uses a case study approach in the context of user-based product design thus, the focus of the research lies on deepening the understanding of user needs through observation and interviews, rather than on the statistical generalization of the population. The purposive selection of subjects was carried out to ensure that the involved sample had the most relevant characteristics to the research objectives (Asrulla et al. 2023). A similar approach was also used in previous research that focused on a limited number of subjects within a single educational institution, taking into account the variation of ADHD characteristics at the research location (Subakti et al. 2022).

In addition, both subjects represent all students with identified ADHD characteristics at the research location. This condition is in line with inclusive education practices, where children with ADHD at certain levels can still participate in learning at regular schools and are not always placed in special schools. These are supported findings that show that children with ADHD often remain in regular classroom environments because their behavioral characteristics are not always identified early in the context of formal learning (Tri Gunadi et al. 2026). Therefore, the number of students with ADHD in a single regular educational institution can be relatively limited.

3.2 Data Collection

Data collection in this study was conducted to obtain comprehensive information regarding user needs and the characteristics of learning media suitable for children with Attention Deficit Hyperactivity Disorder (ADHD). Primary data were collected through direct observation of the learning activities of the research subjects in the classroom to identify learning behaviors, concentration patterns, and responses of students with ADHD toward the instructional media used during the learning process. In addition, semi-structured interviews were conducted with supporting teachers to explore information related to students' learning needs, challenges encountered during classroom instruction, and the characteristics of learning media considered effective for supporting children with ADHD.

Secondary data were obtained through a literature review of previous studies related to ADHD, educational board games, and product design principles for children with special needs. Furthermore, benchmarking was conducted on several existing educational board games and learning media to identify relevant features, game mechanics, and design elements that could serve as references in the product development process.

All the collected data is then translated to formulate user needs (customer needs), which serves as the basis for translating user needs into technical product specifications through the House of Quality (HOQ) matrix within the Quality Function Deployment (QFD) framework. The QFD Phase 1 framework is as follows:

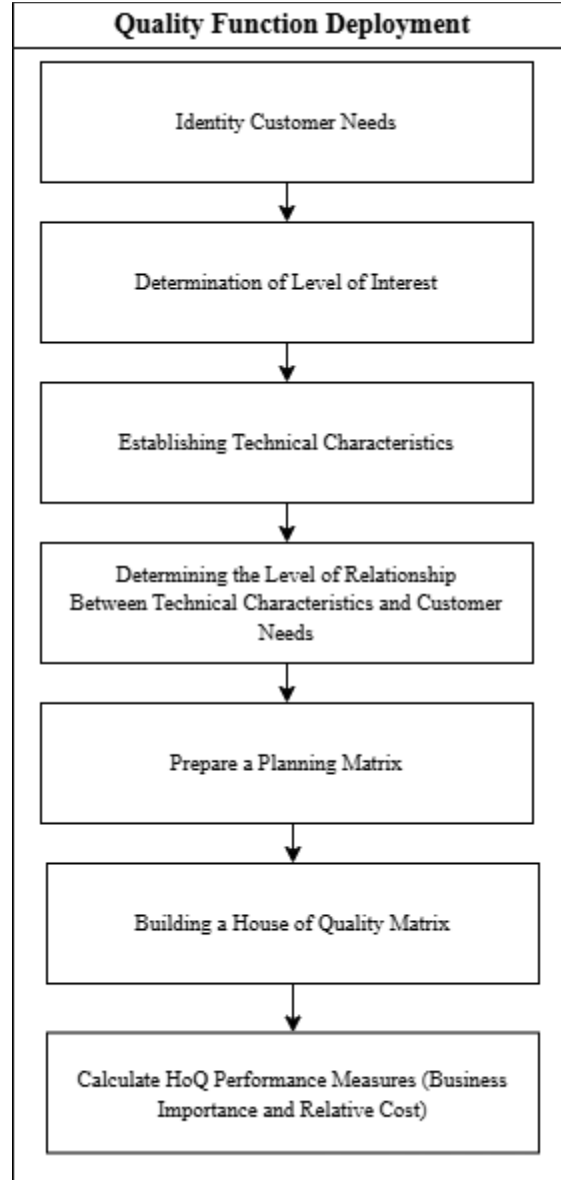


Figure 1. Research framework: Quality Function Deployment (QFD) Phase 1(Ginting et al. 2020)

3.3 Procedure

In Figure 1, the first stage in the implementation of Quality Function Deployment (QFD) begins with the identification of user needs (customer needs), which is the process of collecting and formulating consumer needs and expectations for the product to be developed (Ginting et al. 2020). This information is generally obtained through interviews, observations, or other relevant data collection techniques so that user needs can be comprehensively understood. After the user needs are identified, each need is assigned a level of importance (customer importance) to determine the priority of each need based on user perception (Ginting et al. 2020). The assessment of the level of importance generally uses a specific scale, such as a scale of 1 to 5, to facilitate the process of quantifying customer needs (Ginting et al. 2020).

User needs for the development of the House of Quality (HOQ) were gathered through an interview with a teacher who directly works with children with ADHD at the study school. The respondent was selected because this teacher was the only educator supporting children with ADHD in the class where the study was conducted, and thus possessed the most relevant knowledge and experience regarding the children's characteristics, learning behaviors, and learning

needs Vaughn and Hoza (2013) noted that teachers are one of the key sources of information in the ADHD assessment process. Furthermore, ALdawiah and Tadzkirah (2025) research indicates that interviews with teachers can be used to gather information regarding learning needs, appropriate learning strategies, and the impact of learning media on children with ADHD. Therefore, teachers were selected as key informants to identify user needs, which were then translated into the product's technical characteristics using the House of Quality (HOQ) method. The use of teachers as informants also takes into account the limitations of elementary school-aged children, particularly those with ADHD, in expressing their product needs systematically and consistently during interviews.

The next stage is to establish the technical characteristics of the product (technical response) by translating qualitative user needs into measurable and implementable technical specifications in the product design (Ginting et al. 2020). The determination of technical characteristics is carried out so that each user's needs have a clear technical representation in the design process. Next, an analysis of the relationships between technical characteristics is conducted to identify the correlation between one technical attribute and another (Ginting et al. 2020). This analysis aims to determine whether technical characteristics support each other or have the potential to cause conflicts in the product development process. Then, the relationship between user needs and technical characteristics is analyzed through a relationship matrix to assess the extent to which each technical attribute contributes to meeting user needs (Ginting et al. 2020).

At this stage, a planning matrix is also prepared, which includes setting development targets, improvement ratios, sales importance levels, raw weights, and normalized weights to support the determination of development priorities (Ginting et al. 2020). All the results of the analysis were integrated into the House of Quality (HOQ) matrix as a basis for determining the technical priorities of product development based on the importance level of user needs, technical contributions, and design implementation considerations (Ginting et al. 2020). The resulting technical specifications were subsequently translated into a board game prototype for validation.

After the prototype was developed, a validation process was conducted to assess the board game's design feasibility. The validation involved special education teacher with experience working with children with special needs, including those with ADHD. Before the assessment began, the validators were briefed on the game's concept, learning objectives, game mechanics, and how to use the prototype. The assessment was conducted through interview sessions using a 1–5 Likert scale adapted from (Ramdiani, 2025). The aspects evaluated included the appropriateness of the material, visual design, ease of use, product safety, and the benefits of the medium in supporting the learning of children with ADHD. Feedback from the validators was used as the basis for refining the product design.

4. Results and Discussion

4.1 Need Statement

Identification of user needs (customer needs) was conducted through interviews with ADHD students, accompanied by teacher/class guardian of ADHD students. The teacher has direct understanding of the students' learning characteristics, concentration barriers, and learning needs. The results of the interview with the supervising teacher were then analyzed and grouped into user requirements to represent the general needs of users regarding the learning media. Each of these needs is then translated into more specific need statements as the basis for constructing the House of Quality in the QFD process. The details of the user requirements and need statements are presented in Table 1.

Table 1. Need statements and attributes regarding board games for children with ADHD.

No.	Ergonomic Aspect	User Requirement	Need Statement	Need Attributes
1.	Visual	Users need visually engaging learning media to enhance their attention while studying.	Board games must use a combination of colors and attractive visual elements to capture children's attention during the learning process.	Providing a visually varied and appealing color composition

No.	Ergonomic Aspect	User Requirement	Need Statement	Need Attributes
2.	Cognitive Ergonomics	Users need media that can help them understand word formation material in a more interactive way.	The board game must have educational elements that support word formation activities and understanding of word structure.	Integrating game mechanics for structured word formation activities
3.	Cognitive Support	Users need tools to help review and reinforce their memory of learning materials.	The board game must provide features or mechanisms that allow children to repeat and remember words.	Providing features to support word repetition-based learning
4.	Engagement & Usability	Users need learning media that is enjoyable and flexible to use in various learning environments.	Board games should be designed as enjoyable learning media that can be used both at school and at home.	Providing a fun and flexible interactive gaming experience

As described in Table 1, the first need statement in Table 1, the user requirements obtained from interview process with ADHD elementary School students, were translated into need statements. The need statement is what users need from the board game. The first need of ADHD students is that the Board games must use a combination of colors and attractive visual elements to capture children's attention during the learning process.

4.2 Need Attributes

The user needs previously obtained were translated into needs attributes. This process is carried out to transform general user needs into more specific and structured attributes. The need attributes are the basis for preparing the planning matrix in the Quality Function Deployment (QFD) method. The results of the need statement and need attribute classification are presented in Table 1. For example, the first need statement in Table 1, "Users need an attractive board game color," is categorized under the aspect of visual stimulation and translated into the need attribute "Providing a composition of colors that is varied and visually appealing." This transformation is carried out to ensure that each user need can be translated into more specific, measurable, and relevant design attributes in the technical product development process at the House of Quality (HOQ) stage.

4.3 Technical Specifications

After the transformation of user needs into need attributes, an importance assessment was conducted to determine the relative priority of each attribute before constructing the House of Quality (HOQ). The assessment was performed through structured interviews with elementary school students with ADHD, accompanied by the assistance of a supporting teacher to interpret responses based on the students' cognitive and communicative abilities. The teacher acted solely as a communication facilitator and did not intervene in determining the responses. The resulting importance ratings were subsequently used to rank the need attributes and support the technical prioritization process in the HOQ. Table 2 presents the ranked need attributes, metrics, and their corresponding importance scores.

Table 2. Importance matrix

No	Need Statement	Matrix	Imp.	Units
1.	Board games must use a combination of colors and attractive visual elements to capture children's attention during the learning process.	The number of colors varies.	4	types
2.	The board game must have educational elements that support	The font size of the word element	4	cm
		Number of card elements	5	pcs

	word formation activities and understanding of word structure.	Number of alphabet letter cards	5	pcs
3.	The board game must provide features or mechanisms that allow children to repeat and remember words.	Battery capacity on the device	3	mAh
		Machine weight	3	gram
4.	Board games should be designed as enjoyable learning media that can be used both at school and at home	Dimension Boardgame	5	cm

The table 2. shows the process of translating user needs (need statement) into technical characteristics (technical matrix/metrics) using the Quality Function Deployment (QFD) approach. Each user need that is conceptual in nature is broken down into one or more specific, measurable, and implementable technical parameters (metrics) in the board game design process. This is done so that user's needs can be systematically translated into objective product design specifications. For instance, the first requirement related to the use of color combinations and attractive visual elements is translated into the parameter of the number of color variations. Each metric has different importance rating as scored by the students.

The importance matrix was subsequently integrated into the House of Quality (HOQ) matrix to evaluate the board game specification.

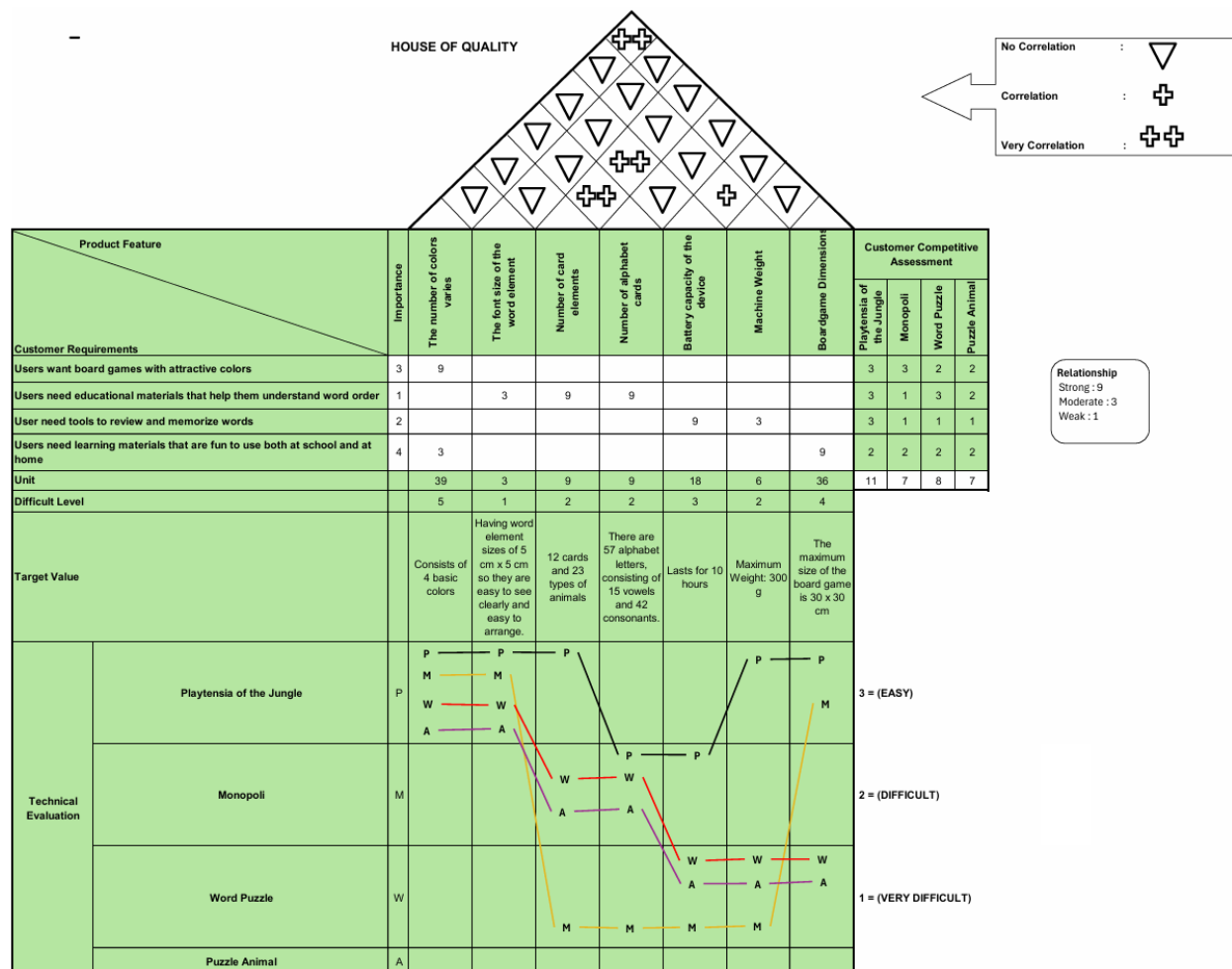


Figure 2. House of Quality

Based on the House of Quality (HOQ) analysis shown in Figure 2, priority weights were obtained for each technical characteristic, indicating their contribution to meeting user needs. The technical characteristics with the highest priority values were identified as the main priorities in the board game development process. In the HOQ matrix, Playtensia of the Jungle refers to the board game concept proposed in this study and is compared with existing educational board games (Monopoly, Word Puzzle, and Puzzle Animal) to assess its ability to fulfill user requirements and technical characteristics. The prioritization results were then translated into technical product specifications, which served as the basis for the final board game design. The resulting specifications are presented in Table 3.

Table 3. Boardgame Specification

No.	Matrics	Target Value	Component Material Specifications / Dimensions
1.	The number of colors varies.	Consists of 4 basic colors	Colors: Green, blue, brown, grey
2.	Dimension Boardgame	The right dimensions for a board game component	Wood size: 30 × 30 cm
			Thick plastic weight: 67-80g
			Sound card size: 7 cm x 4 cm.
3.	Battery capacity on the device	Lasts for 10 hours	Battery capacity: 100-300mAh

Based on the results of the House of Quality (HOQ) analysis, color variation is one of the technical characteristics with the highest priority weight in board game development. The selection of colors is intended not only to enhance visual appeal but also to support user attention and engagement during the learning process. Research findings by Dzulkifli and Mustafar (2013) explain that color can increase attention and cognitive arousal, which contribute to the process of storing information in memory. Additionally, Rahmawati et al. (2024) state that the use of bright, high-contrast colors can create a pleasant atmosphere and encourage children to be more active and enthusiastic while playing.

This board game uses a combination of nature-based colors: green, blue, brown, and gray, that align with the jungle theme. The choice of green is based on research by Kexiu et al. (2021), which shows that green and other natural colors can have a relaxing and comforting effect, as well as enhance users' visual engagement. Research by Zheng et al. (2024) also found that natural color combinations dominated by green are capable of producing a more pronounced relaxing effect and positive emotional responses compared to more stimulating colors (Zheng et al. 2024). Furthermore, the color green is synonymous with trees and vegetation, which are key elements of a jungle environment, related to the animal features used in this board game.

The color blue is used to represent the elements of sky and water, which are closely tied to the natural environment. According to Mulyati (2022), based on color psychology, blue conveys a sense of calm, peace, safety, and stability, thereby creating a more comfortable learning environment. Additionally, brown was chosen to depict tree trunks and soil as part of the forest ecosystem. Research by Putra et al. (2023) explained that brown conveys a sense of warmth, support, and calm, thereby enhancing users' comfort when interacting with the learning materials (Putra et al., 2023). Meanwhile, gray was used as a neutral color to maintain visual balance. Research by Andriputri and Dewiyanti (2024) noted that shades of gray are considered safe and can help stabilize emotions because they create a sense of calm without being visually overwhelming (Andriputri and Dewiyanti 2024). The combination of these four colors was chosen not only to reinforce the forest theme but also to create a visual appearance that is appealing, comfortable, and does not cause excessive stimulation.

The second priority is the dimensions of the board game, which are implemented in a product size of 30 × 30 cm using a wooden base material. This dimension was determined based on two main considerations. First, the House of Quality (HOQ) analysis identified board game dimensions as one of the technical characteristics with the highest priority weight. Second, the selected size was adjusted to the anthropometric characteristics of Indonesian children (*Antropometri Indonesia*, n.d.). Based on anthropometric data, the forearm hand length (D23) of Indonesian children is approximately 27.12 cm; therefore, the board game dimension was rounded to 30 cm to ensure that all game areas remain comfortably reachable during play. In addition, previous board game studies generally employed dimensions ranging from 25 to 40 cm, such as the board game developed by Evhintyas and Gundo (2025) with a size of 45 × 25 cm, Antonia and Ramadhani (2025) with a size of 35 × 35 cm, and Rizkha and Anggapuspa (2022) with a size of 40

× 40 cm. Considering these references and the anthropometric suitability for children with ADHD, a dimension of 30 × 30 cm was selected as the most appropriate size. This dimension provides sufficient space to accommodate game paths, animal illustrations, pawns, and supporting components without creating excessive visual clutter, while also allowing the board game to be comfortably used on standard desks at school or at home. Therefore, the selected dimension represents a balance between ergonomic suitability, visual readability, ease of interaction, and product portability.

In terms of the dimensions of the supporting components, the design also includes the use of a lightweight plastic of 67–80 grams and a sound card of 7 × 4 cm to ensure they remain proportional to the overall size of the board game. Next, the third priority regarding the battery capacity of the device is implemented through the use of an audio module (sound card) with an operational endurance of approximately 10 hours to support the optimal use of the sound feature during the learning activities. The relationship between the technical priorities of the HOQ results and the detailed product specifications indicates that the board game design has been systematically developed based on user needs, which have been translated into measurable and applicable design parameters.

The results of the technical prioritization through the House of Quality (HOQ) are then implemented into the product design development process to ensure that the resulting board game design aligns with the identified user needs. The final design of the developed board game (the board part) is shown in Figure 3.



Figure 3. Resulted Board Game “Playtensia of the Jungle”

The board game is named “Playtensia of the Jungle”. As previously captured through HOQ, this board game is equipped with several supporting components, such as:

1. Puzzle. The puzzle is used before the game begins. Players first assemble the puzzle pieces to form the game board, which will serve as the base for the board game. This activity is designed to help children practice their focus and prepare them before entering the main game.
2. Game Pieces and Dice. Game pieces are used to mark each player’s position on the game board, while the dice are used to determine the number of spaces a player can move on each turn.
3. Spelling Cards. Spelling cards consist of letters A–Z used to spell out animal names corresponding to the squares occupied by players. These cards serve to practice letter recognition, spelling skills, and concentration during the game.
4. Animal Cards and the Talking Flashcard Machine. Animal cards feature images and names of animals corresponding to the squares on the game board. When a pawn lands on an animal square, the player must first locate the matching animal card, then spell out the animal’s name using the spelling cards. Once the letters are correctly arranged, the animal card is inserted into the Talking Flashcard Machine. This machine will provide audio feedback in the form of the animal’s name and its characteristic sound. The combination of animal cards, spelling cards, and the audio machine is designed to provide simultaneous visual, kinesthetic, and auditory stimulation, making the learning process more engaging and helping to improve the attention and concentration of children with ADHD.
5. Players who successfully spell out an animal’s name and find the corresponding animal card may move forward one space. If they fail, they must draw a challenge card. If they cannot answer the challenge correctly, they must move back two spaces.
6. Game Concept and Flow. The concept of “Playtensia of the Jungle” adapts the basic mechanics of Monopoly and Snakes and Ladders, simplifying them to better suit the needs of children with ADHD. Players move

along the game board, spell out animal names, identify animal sounds, and complete challenges that arise during the game until they reach the finish line.

4.4 Validation

The resulting board game design is expected to help elementary school children with ADHD to better participate in learning activities by increasing students' concentration. The board game prototype was validated through interview sessions with evaluations by media experts, specifically special education teachers with experience in assisting children with special needs, using a 1–5 Likert scale-based assessment instrument with evaluation items adapted from (Ramdiani, 2025). Before the evaluation process was conducted, the validators were explained the product concept, learning objectives, game mechanics, and a demonstration of the prototype board game's usage. The aspects evaluated in the validation process include the suitability of the learning materials, the visual design of the media, ease of use, product safety, and the usefulness of the board game in supporting the learning process of children with ADHD. Based on the evaluation results, the board game received a total score of 72 out of a maximum score of 90, resulting in a feasibility percentage of 80% and falling into the "feasible" category according to the media feasibility interpretation (Ernawati, 2017). The assessment results indicate that the board game has met the main feasibility aspects, particularly in visual appeal, the suitability of the game concept with the characteristics of children with ADHD, and ease of use in learning activities. Although generally deemed suitable without requiring major revisions, the validators still provided some suggestions for improvement, such as simplifying the number of visual illustrations and standardizing design elements to minimize potential distractions during gameplay. Based on the results, it can be concluded that the design of the Boardgame Playtensia of the Jungle has met the feasibility criteria as an interactive learning medium and is deemed suitable to support the improvement of concentration in children with ADHD.

The research results show that the design of the Board game Playtensia of the Jungle, developed through the Quality Function Deployment (QFD) approach, successfully resulted to an interactive learning tool suitable for children with Attention Deficit Hyperactivity Disorder (ADHD), with a feasibility level of 80% based on media expert validation. The technical priorities obtained from the House of Quality analysis indicate that aspects of visual stimulation, cognitive learning support, and multisensory interactive features are the main elements in product development. These findings indicate that user needs have been systematically translated into product design attributes relevant to the learning characteristics of children with ADHD.

The results of this research are in line with the research by Ningtyas (2023), which states that board games are interactive play media capable of creating a collaborative learning environment through play activities on the surface of structured physical games. These characteristics support active learning because they allow students to engage directly in learning activities through the manipulation of game objects. Furthermore, Putri et al. (2024) explained that the structure of rules and the use of physical components in board games allow for sensorimotor stimulation that supports user engagement in the learning process.

The findings of this study also support the results of Maryanti et al. (2021) research, which states that board games can integrate cognitive activities, communication, and reasoning into recreational play activities. Thus, learning does not only occur passively but through direct experience (experiential learning). In the context of this research, the integration of puzzles, word formation, audio, and turn-based systems in the game shows that the designed board game not only serves as an entertainment tool but also as a structured cognitive stimulation tool for children with ADHD. Furthermore, the use of a challenge and turn-based game mechanism in the developed board game is also in line with Fadli et al. (2025) findings, which state that board games can enhance critical thinking skills, creativity, and strategic planning in problem-solving. In this study, the game system is designed so that children follow turn-taking rules, form words, and complete learning challenges, which indirectly also train focus, discipline, and behavioral control.

In addition, the fun and competitive board game design resulting from this study also supports Hashim et al. (2024) research that found the board games function in enhancing students' learning motivation and self-confidence through a more relaxed learning atmosphere focused on achieving game objectives. This is relevant to the characteristics of ADHD children who tend to be more responsive to interactive learning activities compared to conventional passive methods.

Nevertheless, compared to previous research on educational board games that generally focused on evaluating the effectiveness of the game on learning outcomes, this study provides an additional contribution through the application of a QFD-based product engineering approach in the process of developing learning media. This approach allows the

design process to be carried out in a more systematic and measurable manner because each product element is designed based on user needs that have been mapped through the voice of customer and the House of Quality. Thus, this research not only produces board game-based learning media but also offers a more structured product development framework for designing educational media for children with special needs.

6. Conclusion

This study successfully designed the educational board game “Playtensia of the Jungle” as an interactive learning tool aimed at helping improve concentration in children with Attention Deficit Hyperactivity Disorder (ADHD) in elementary school. The design process utilized the Quality Function Deployment (QFD) method to systematically translate user needs into technical product specifications. Analysis results indicate that visual aspects and interactive features were the top priorities in product development, which were then realized through the implementation of jungle- and ocean-themed designs, the use of attractive colors, the integration of audio features, and interactive board game-based gameplay mechanics.

Based on validation results by media experts, the board game achieved an 80% feasibility rating and was classified as suitable as an interactive learning tool for children with ADHD. These findings indicate that the product design has met user needs and aligns with the established development objectives. Furthermore, the integration of visual, audio, and interactive game elements in the board game is considered to have the potential to create a more engaging, adaptive, and suitable learning experience for children with ADHD compared to conventional learning media.

Nevertheless, this study still has limitations because the effectiveness of using board games is assumed to require teacher guidance during the learning process and depends on a conducive learning environment. Therefore, future research is recommended to conduct direct experimental testing with a larger sample of participants to quantitatively measure the effectiveness of board games in improving the learning concentration of children with ADHD. Future work could include classroom testing with a larger group of children to measure its impact on concentration and learning engagement.

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