# Logical Thinking Tools for Better Communication In Young Children

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## Abstract

Communication is one of the important things in everyday life. We communicate to create mutual understanding. Every response will be critical thinking and leads to logical thinking since the left brain has the ability to control communication and choose suitable words. Young children of ages 9-11 years are the curious generation who want to ask questions and find the answers through the surroundings. Thus, this age range is suitable for developing logical thinking that affects communication in the future. The authors were inspired by toys for practicing a skill in kids designed by Bruno Munari, a designer who specialized in designing toys for developing a child's personality and various skills in different ages. Therefore, the authors were interested to design a board game for young children. The main design of a board game is to connect the chips on the board to create a story. The chips are in a hexagon shape since it is the best among the three test shapes. The hexagon chips can be connected at all corners without leaving a blank space. On the chips, there were pictograms that guide the players to create a new story, express their thinking, and communicate by connecting the chips on the board. A variety of pictograms on the chips will require the players to plan and arrange the story sequence before playing to keep every chip in the same context. In conclusion, this research has developed a board game and a set of educational materials to develop logical thinking for better communication in young children.

***Keywords*****:** *Logical thinking, Logical tools, Creativity, Communication*

## 1. Introduction

Communication is very important in everyday life and is necessary for work, however, communication can also be a problem. Miscommunication can have many implications. To become a person who has good communication starts from knowing what is communication. A theory of communication by David Berlo in 1960 talks about the composition of communication, which is called the SMCR model due to its four components; source, message, channel, and receiver (Berlo, 1960).

- Source: all communication has its origin. It can be an individual or a group and the function of the source is to "encode" the message to be communicated. The source is affected by several attributes such as communication skills.
- Message: the source must have the message to understand what it is meant to convey. In this case, "content" refers to everything that is communicated deliberately and casually. For example, elements of the communication might include speech, body language, and slides shared during a presentation. Formal or informal, the content must comply with the way the source requires recipients to interpret the message. Except for the simplest text, it has to be structured so that multilayered messages are transmitted logically and cumulatively. It must also be properly encoded, with clear examples using language that the recipient understands what they want to communicate.
- Channel: Berlo's channel is clearly involved in the senses and points out that the ability to communicate messages that are not words. Communicating in different environments affects communication, including touch, smell, and taste. For the recipients to decrypt the message properly, it depends on the channel selection as well.



*Proceedings of RSU International Research Conference (2021)*

- Receiver: A receiver is a person who receives the message. They are responsible for decoding the message the messengers are trying to convey. For the recipients to interpret the matter exactly as the communication partner, it relies on several factors such as shared experience.

This model was developed based on the concept of communication by Aristotle 2,300 years ago. It was Aristotle who first noted that it was the recipient who held the key to whether the communication is effective or not. Berlo's model had no suggestion, but it is always helpful for the source and recipient to exchange the location, replay the message in the opposite direction, and confirm the understanding. Following is the chart of the SMCR theory (Figure 1).

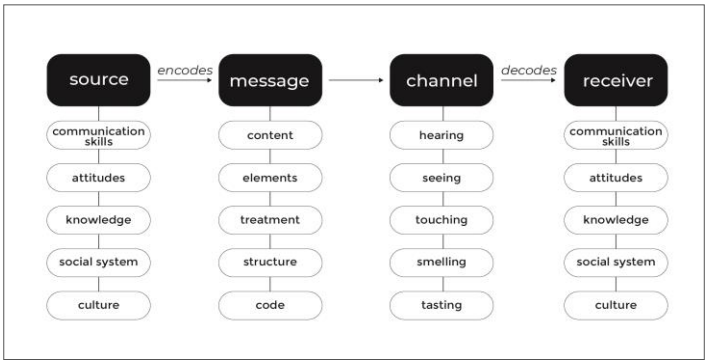


**Figure 1** Chart of the SMCR theory, the concept of communication (Berlo, 1960)

There is a connection between communication and the human brain. The left side of the brain controls expression, common sense, analysis, and detail, organizes the priority of information and thought logically, and analyzes and interprets symbols in the alphabet language. The left brain involves perception as specializing in sciences, calculation of addition, subtraction, multiplication, and division, and administrative numbers that must be managed and planned logically. It must be aware of for people who use too much of their left brain since it can create high stress and is dangerous to health. Below is the figure of brain lateralization (Sperry,1961).

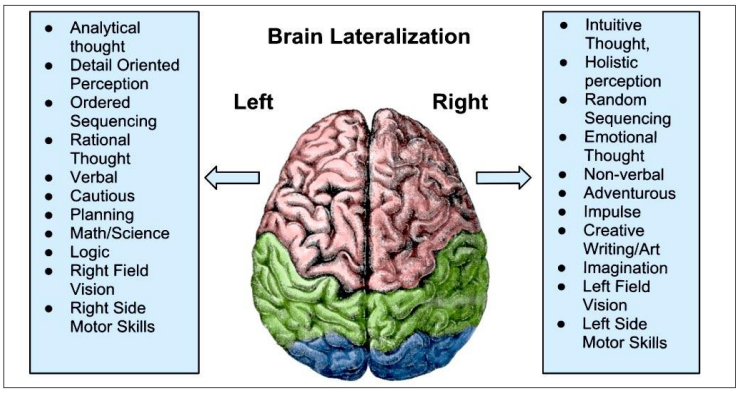


**Figure 2** Functions and connection between the communication and human brain (The Human Memory, 2020)

Late childhood is the age range of between 9-12 years in the elementary and upper elementary grades, thus it is more common to refer to this age as school age. Most of their lives are outside the house. They prefer to go to friends' houses, stadiums, or venues and begin to learn social values from a group of peers or teachers and develop analytical and comparative thinking. Late childhood (school age) has the following characteristics.

- Curiosity: At this age, the children are very curious just like when they were younger and wanted to experiment. They will ask with more curiosity, want to know the reason, and want to know things like How was it? Why it was born? and want to read books to find out.
- Attention, concentration, and discipline: The attention span will be longer. They will try to complete the task they are interested in such as collecting interesting items or handcraft and want to master their skills to gain more mastery. This age is considered as the critical period since the children begin to develop their need for fulfillment, which is to create a habit that leads to success though it depends on the abilities of each child.

Extremely interested in family activities began to contribute comments within the family children need to show others that they are handsome children will convince or discuss adult powers with their peers' opinions at the same age, teachers often found it difficult for school-age children to become independent (Craig, & Baucum, 1999).

The development of logical thinking skill for kids have 2 methods; the first method is from the leaning system taught in school and the second is the medical treatment method (Kalaya, 2019). Most medical treatments use toys that focus on brain development. It is different from the school that develops children's logical thinking through the main subjects like mathematics and science. "Coding" has been officially assigned as a new subject for Thai students, starting from grade 1, in November 2019. The Ministry of Education of Thailand aimed to encourage the study of Coding as a part of science. The meaning of Coding is C as creative thinking, O as organized thinking, D as digital literacy, I as innovation, N as newness, and G as globalization. The main concept of Coding is in-plug (with the use of a computer) and unplugged (without a computer) (Kalaya, 2019).

From reviewing previous design works by Bruno Munari, a graphic designer in Italy who designed books and games, it was found that education was fundamental in the production of his work during the 1940s. Munari paid special attention to the importance of the games as useful tools for developing a child's personality and various skills. So he later put his attention on the production of games and toys. He dedicated his creative activity to every form of "experimentation" and started with designing for children, such as children's books that combined play and education. His works have been a fundamental reference in art production and the development of logical thinking. He cultivated these influences with extraordinary results in his picture books. The following analysis of some of Munari's passages offers an important historical perspective on the value, function, and performance of mass production (Campagnaro, 2016).

## 2. Objective

To design a board game for developing logical thinking to improve communication in children

## 3. Materials and Methods

3.1 The previous board games designed by Bruno Munari, a reputation designer, were studied and the critical thinking of those board games was then extracted. The board games were namely ABC con fantasia, Eight sequences, Plus and Minus, Metti Le Foglie, and MC 1 Architecture Box.

3.2 Three basic shapes of chips (Figure 3) were tested for their functionality of connecting to create a variety of patterns such as linear, branch, and others. The difference between each pattern reflects the individual expanded thinking that depends on the organized and planned design. Three basic shapes of the chip models were 1) long octagon, 2) octagon, and 3) hexagon.

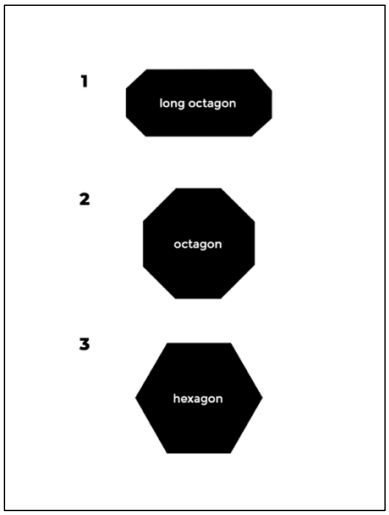


**figure 3** The basic 3 models of chips for creating the story when connected

3.3 Decorations such as color, texture, and nature pictures are applied to enhance more creativity of the players.

3.4 A set of boardgame was developed using the selected chip shape. Some textured designs were developed to draw more attraction and visualize the effect for the children.

## 4. Result and Discussions

*4.1 Critical thinking from studying ABC con fantasia by Bruno Munari*

Bruno Munari is a designer who is interested to improve the logic, critical, creativity, imagination, or language of people using his creative work (Munari, 2020). In this research, the first example design is ABC con fantasia (Figure 4). This game is to assemble several straight or curved elements to create a capital letter of the English alphabet or any other drawings. The elements can be arranged either vertically, horizontally, or diagonally and can be put in many directions. To win this game, the player will have to complete the alphabet by trial and error (Campagnaro, 2016).


**Figure 4** Example design of ABC con fantasia by Bruno Munari (Corraini Edizioni, n.d.)

The author has extracted and summarized the structures of the elements (Figure 5), which are the important parts of the alphabet. The elements are straight lines, semi-circles, and curves. Different directions of the straight lines can provide different characters. These elements can be assembled to create other alphabets. Therefore, the children can develop their thinking with fun by this game.

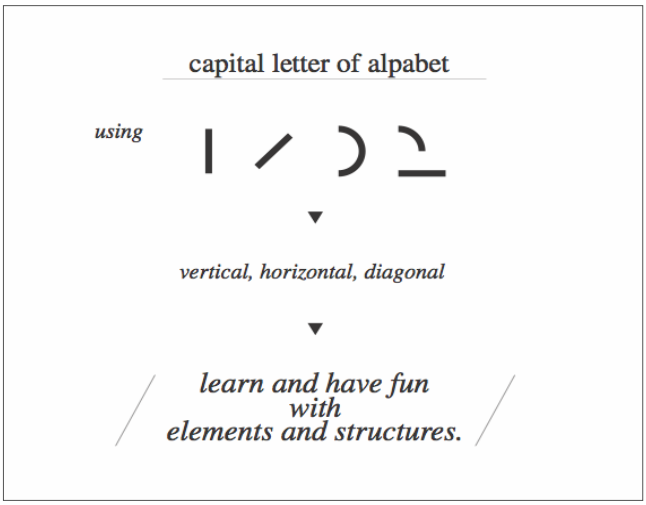


**Figure 5** The structure of ABC con fantasia as summarized by the author

*4.1.1 Critical thinking from studying Eight Sequences To Put In Order by Bruno Munari*

The game Eight Sequences to Put in Order (Figure 6) was designed in 1976 by Bruno Munari. This game composes 52 cards that can be ordered to form eight sequences of logically ordered images. Each sequence can be made up of 3 to 10 cards. The concept is to create an image sequence to shape the story or to lead to new stories or new meanings to strengthen and enhance proficiency in logic. For example, the cards can be described as a bird coming out of a cage, a house under structuring, or a plant that grows leaves and blooms (Corraini Edizioni, n. d.).

**Figure 6** Example design of Eight Sequences to Put in Order by Bruno Munari (Edizioni, online)

In summary, the structure of this game card teaches about the position, perspective, and size of the elements, which all of these give different results. For instance, the first example in Figure 7 shows the cards that were arranged to sequence the bouncing of the circle, teaching about the position, whereas another example shows an arrangement of the cards that sequence the growing of the rectangle, which teaches about vision distance (near or far). So this game card depends on the sequences when arranging the cards to tell different stories and meanings.

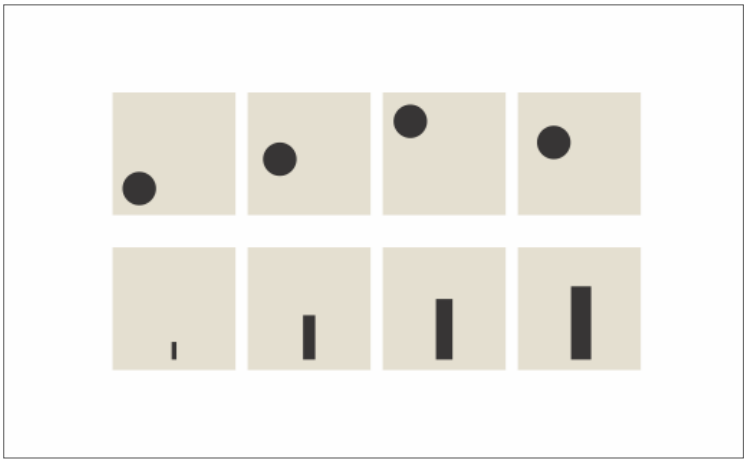

**Figure 7** The cards arranged in sequences to tell about position and perspective

*4.1.2 Critical thinking from studying Plus and Minus by Bruno Munari*

The work in Figure 8 is called Plus and Minus, which used a "see-through" technique and theme of transparency. This game composed many several images on a transparent background that can be combined and mixed at the player's decision to add or remove them. The player can combine many pictures following their imagination and perspective to create stories that are bonded together not just the pictures. This game can create countless combinations using the suggestions at their disposal, without rules. In summary, it is like carrying and reconstructing images or stories by adding or removing imaginary overlays to create new images

(Corraini Edizioni, n.d.).

**Figure 8** Example design of Plus and Minus by Bruno Munari (Munari & Belgrano,1968)

The author has extracted and summarized the structure of the elements (Figure 9) and found that the important focus point is to combine pictures to create a new story. The player can pick up the pictures, add more pictures or remove, and overlay them to sequence the new story or new picture. Every combination will give a different result.

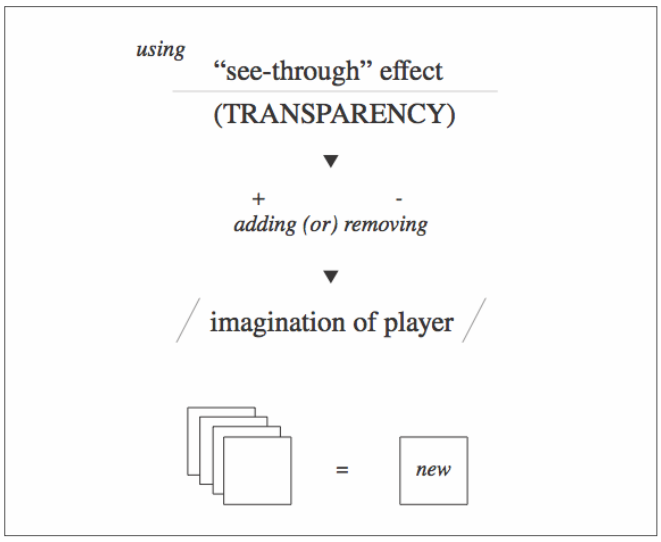


**Figure 9** The basic structure of Plus and Minus as summarized by the author

*4.1.3 Critical thinking from studying the Metti Le Foglie by Bruno Munari*

This one is a box game called "Metti Le Foglie" (Figure 10), which offers a set of natural elements for knowledge about trees. The game includes 50 sheets of black and white paper, each with different drawings of a tree without leaves, and several leaf-shaped stamps. The children can draw the tree themselves by stamping the leaves on the tree. It is also possible to "live" the trees with two seals: a butterfly and a grasshopper. The recommended age of the player is 5-9 years to practice their thinking in choosing the right position and analytical thinking in learning the story of natural position (Serena.,2013).

**Figure 10** Example design of Metti Le Foglie By Bruno Munari (Munari, 2019)

The author has extracted and summarized the structure of the elements (Figure 11) and found that the game used a concept of a tree to guide the positions for stamping the leaves on it. The player can practice thinking by selecting appropriate positions or sizes of leaves and also learn about the nature of trees.

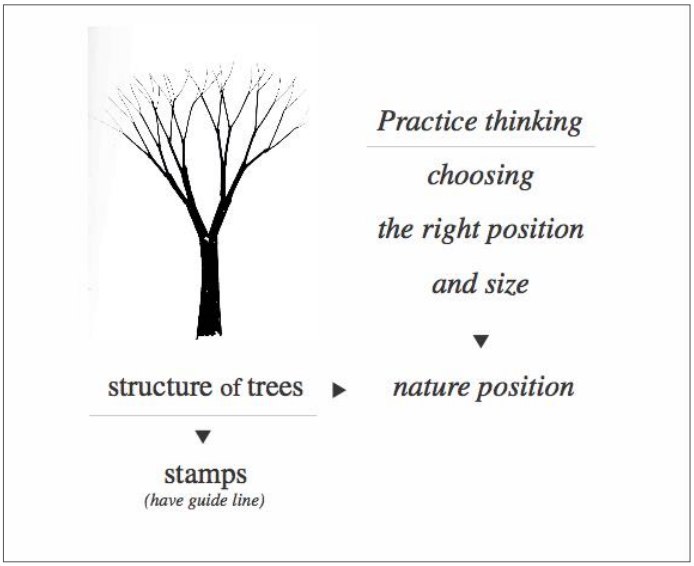


**Figure 11** The structure of Metti Le Foglie as summarized by the author

*4.1.4 Critical thinking from studying MC 1 Architecture Box by Bruno Munari*

Bruno Munari's MC 1 Architecture Box (Figure 12) was first designed and produced in 1945. The main concept of this box uses different shaped "bricks" that can be combined to create an amazing variety of buildings and architectural structures. The player can build many buildings, such as houses to skyscrapers, ancient castles to modern garages, hotels, factories, aqueducts, stations, monuments, hangars, houses with porticoes, terraces, or balconies, in both vintage and modern. Each time the player puts one of these multi-faceted bricks next to another, even at random, a new idea will form in their mind for another building. This

box can develop a creative and artistic set for the player's imagination. The enclosed booklet has over sixty building examples to try and the possibilities are only limited by the player's architectural imagination.

**Figure 12** Example design of MC 1 Architecture Box by Bruno Munari (Munari, 1945)

*4.2 The connection of 3 basic chips*

Figure 13 shows an example of the connected long octagon chips. Though the octagon shape has six active sides, all sides could not be connected. To create a variety of patterns, the suitable side is the cut-edge side, as shown in Figure 13. The connection of the chips requires a rather big area, which may be the drawback of the long octagon chips.

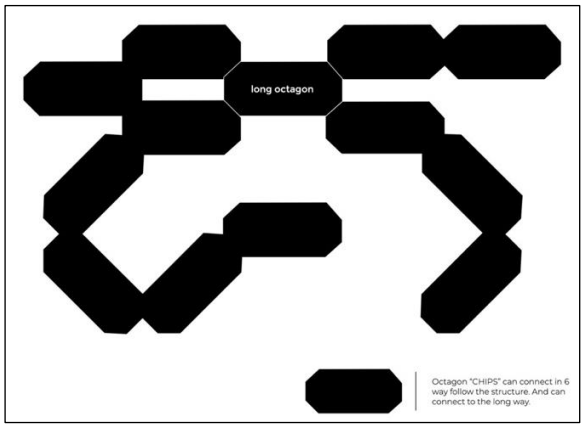


**Figure 13** Long octagons and example of the big picture when connected

Figure 14 shows the connection of the octagons. This pattern can save space more than the long octagons and also give different patterns when connected. The octagon has an equal 8 sites in which every side can be connected and provide a variety of blank space like in the example in Figure 14. The expansion of the connected octagons at all sides provides a good point that increases the possibility when connecting at the corners.

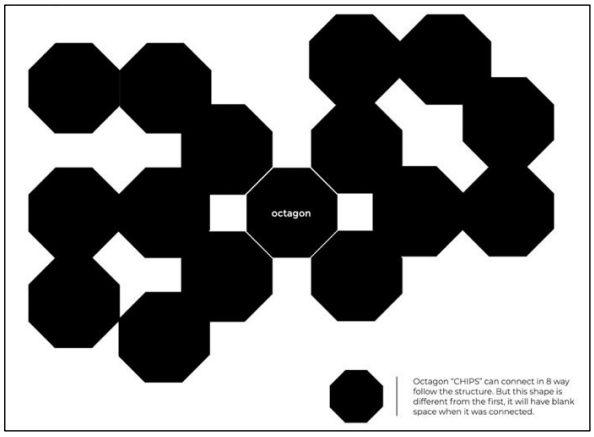


**Figure 14** The series of octagons with a variety of patterns and blank spaces

The last model is the hexagon (Figure 15) that has 6 corners. All sides of the hexagon can be connected without leaving any blank space. It is the only shape of the 3 models that can create a complete tiled pattern.

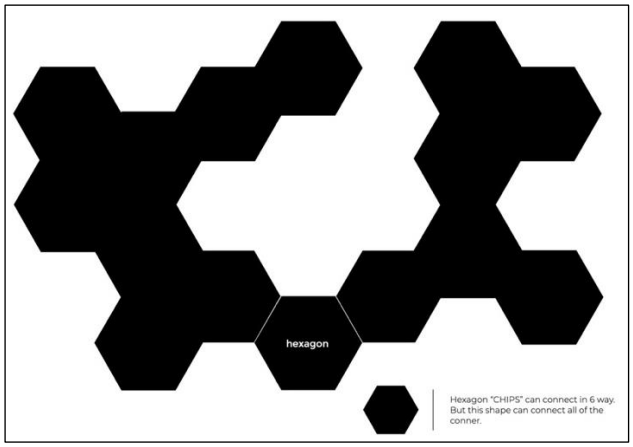


**Figure 15** The example of the connected hexagons

After testing the connection of the 3 basic chips, it was found that the hexagon is the best. It can be connected at all sides to create a big picture without leaving any blank space. For this reason, this shape increases the complexity and every side should have the same context when connected.

*4.3 Decorations for the chips*

In this step, the decorations for the chips were applied. Some graphic elements such as pictograms, geometric shapes, patterns, colors, sizes, and dimensions can support the players to create the stories by connecting them. The examples of the graphic designs for the chips are shown in Figure 16.

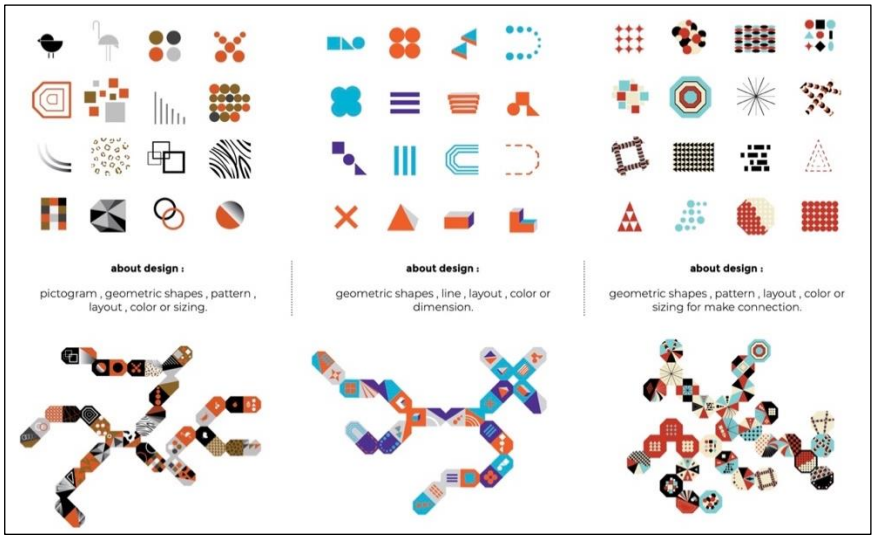


**Figure 16** Three kinds of graphic designs that were applied to the geometric chips

Figure 17 shows the decorated chips made from octagon-shaped printed papers. This set of the board game was tested by a sample child. The result from the test showed that most of the chips can be connected with a hint from their graphic pictures. The elements on the chips are abstract and do not have a meaning. The kid only used his observation to connect chips with similar graphics, meaning that logical thinking was not developed enough and the story should be added to create the conditions.

**Figure 17** The design testing with a sample child to investigate the results for development

Then, the stories were added to the chips by choosing from the topic surrounding young children. In this regard, the topic of nature was selected and the pictograms of the natural environment were added to the

chips (Figure 18). Nature is one of the topics that children are interested in and should be encouraged to explore.

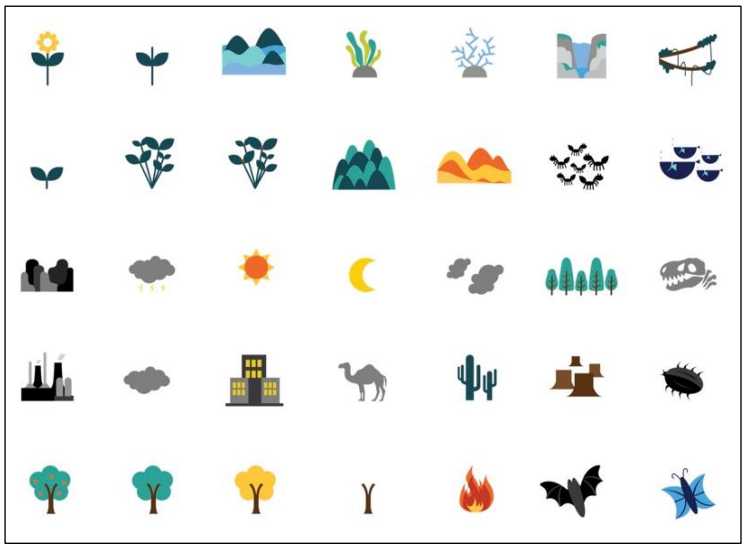

**figure 18** The first pictograms of nature that were added to the chips for creating the construction

*4.4 A box set of the board game*

A box set of the board game was designed for kids aged 9-11 years (Figure 19). The board game can develop their logical thinking to improve communication by using the chips that can be connected to expand thinking, encourage the practice of planning and deciding, and increase creativity. All materials in this box set are made of paper.


**Figure 19** The final box of Relationship of Environment, a board game to develop logical thinking for kids

The box set includes an instruction for the players that indicates how to play, score sheets, chips stand, a bag, chips, and stickers (Figure 20). Figure 21 is the final printout of all elements.

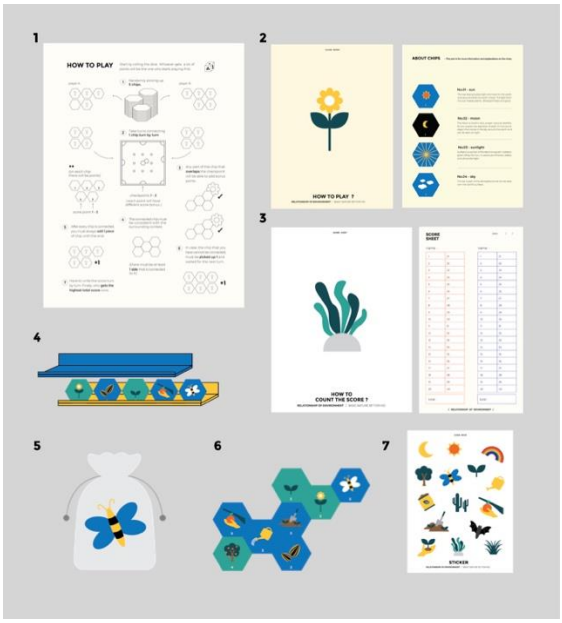


**Figure 20** All elements of the relationship of the environment box


**Figure 21** The final elements inside the box set and the instruction

Since this board game is for developing logical thinking for communication so every chip was designed by using the structure of the sentence, which consists of S + V + (O) (subject + verb + object)

expressing through graphics and pictograms (Figure 22). The examples are “planted a plant” and “watering the plant,” in which the sentences were transformed into pictograms and printed on the chips. The players will learn to use the chips they had to create a suitable story.

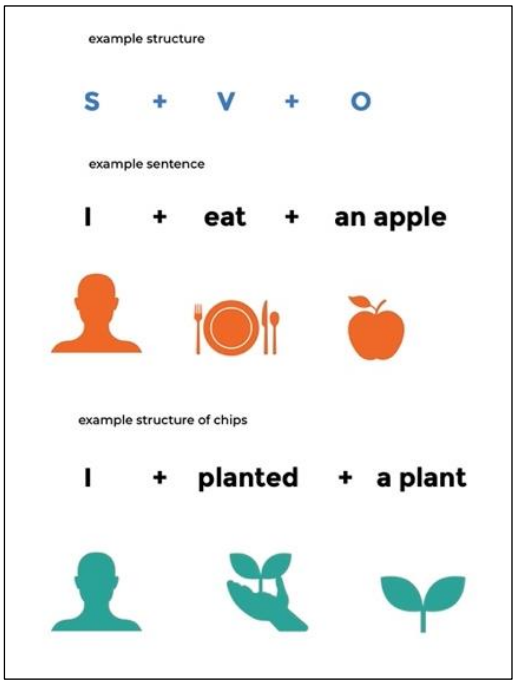


**Figure 22** The structure of the sentences and chips

Figure 23 shows the details of the chips. Each of the 60 chips will have 2 sides; front and back (Figure 24). The front side has 2 elements, which the pictograms and scores while the backside has chip number, name, basic information, a small sentence of each chip (deep information will be explained in the book), and the connection number (which is the answer of the chips telling the possibility of each chip that can be connected) for when the players are not sure whether the chips they got can be connected.

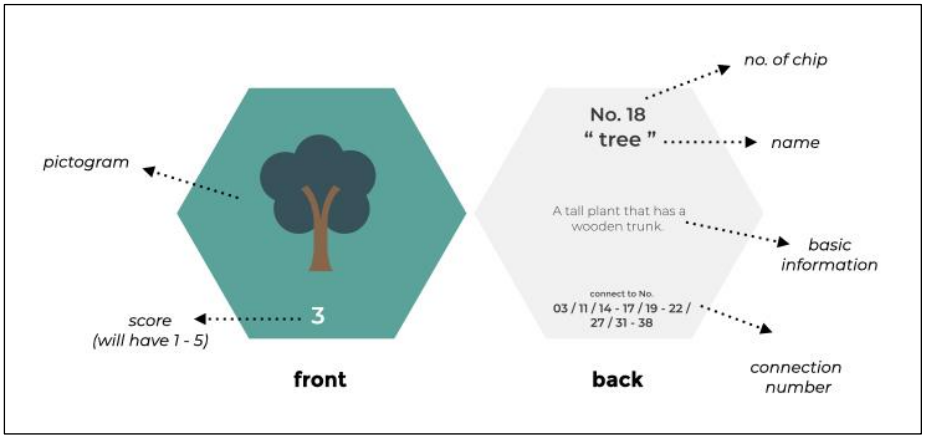


**Figure 23** The structure and details of the chips

**Figure 24** The example front and back views of the chips

The board design (Figure 25) also uses papers as a material. The game requires two players to see in the same position. The board can be rotated and has checkpoint numbers 1 to 5. Every checkpoint will have a bonus score to guide the position and direction. The player has to plan where to put the chips and direction on the board to get the highest score. However, it is unnecessary to go to all of the five checkpoints because every created connection will give different results and scores. The player can select the way to create stories or block competitors and every player will start from the point in the middle of the board.

**Figure 25** The final board (can see in 2 positions) with all of the chips

How to play the board game

1) The game starts by rolling the dice. Whoever gets the highest score will be the first player.
2) Then, the player randomly picks up 5 chips and takes their turn by connecting only 1 chip.
3) After putting the chip on the board, the player has to write the score on the score sheet.
4) To complete their turn, the player must always pick up one more chip.
5) If the player cannot connect the chips in their hand, they have to pick up one more chip and wait to play in the next turn.
6) The player can challenge to see the response behind the chips and more details in the book.
7) To end the game, the player who gets the highest score is the winner.

After playing, this board game will make the players learn to manage the chips in their hands and plan the directions to create the story. It is not important to go to every checkpoint (1-5) since this game focuses on the creation of the story. If the player can create a lot of connections on the board, they can also get a higher score too. The results will be different depending on the players' planning and on the random of the chips. The players can practice and learn by the system and structure that were added in the design, which leads to logical thinking and creativity.

## 5. Conclusion

This project starts with the word of communication since it is very crucial in everyday life. People communicate to create a mutual understanding and every response will be critical thinking. The human left brain has the ability to choose the words for communicating. If some tools for developing logical thinking (the left brain) were used, communication will be enhanced. To select the target group, the author foresaw that the young children of ages 9-11 years are the curious generation that wants to ask questions and find the answers within the surroundings, thus they are suitable for developing logical thinking. To develop our own tool, previous designs for kids by Bruno Munari, a designer who specialized in designing toys to develop skills for kids of different ages, were studied for their critical thinking enhancement. Besides, the author studied how to develop logical thinking in general. For instance, in school, the children develop this skill through science subjects, activities, and toys. From all mentioned above, the author was interested to design a board game for developing logical thinking in kids. The key elements are chips and a board. The chips are made of a hexagon shape and have graphic pictograms on them, the player can plan to put the chips on the board to create a story in which all chips should be in the same context. The chips can be connected to all 6 sides, which increases the possibility and complexity of each chip when connected. In the last step, the board game was designed and the box set was fabricated. This board game can be a set of educational materials.

## 6. Acknowledgements

The work would not be possible without the help and support of my teachers and peers at Rangsit University; Ajarn Sridhar, Ajarn Tnop, Ajan David and the M.F.A. Design class of 2020.

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