



Research Article

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Graphic Design for Children with Learning Disabilities Based on the Isaan Mural Painting

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Abstract

The study of 'Graphic design for children with learning disabilities' is a study that delves into learning-disabled children in the Isaan region. The author used the survey to formulate a graphic and media design model to enhance LD children's learning. This paper is a qualitative study of the data retrieved from the literature review and field data. Target groups include experts, practitioners, and stakeholders. Research instruments are structured and non-structured interviews, observation forms, and tests. The collected data were then analyzed using the 'information processing theory,' 'structural-functional theory,' 'product design principle,' and graphic design element principle. The paper presents the result using descriptive analysis. Based on the study, it was found that the cause for learning disabilities in children living in Isaan mostly concerns with environmental learning disabilities. The best period for children with learning disabilities to effectively receive help is during their early primary or elementary education. The types of learning disabilities that can be found in children in the Isaan region are mostly reading and writing disabilities. Further, it was also revealed that Nakhonratchasima Primary Education Service Area 2 has the highest rate of learning-disabled children in Isaan. Most of the children with learning disabilities did not receive proper care from their caretakers. To identify children with learning disabilities, the author collaborated with the children's caretakers, schools, Special Education Bureau, and hospitals. Common classroom behaviors among these children are their inability to read and write; this includes difficulties in social interactions and activity participation. As for the learning materials, it is clear that the materials used did not correspond with their special needs due to their disabilities. It is clear that these children need materials made for individual use that does not require participation in front of the class or learning through multimedia. The discovery can be used as a guideline in formulating graphic design. The graphic design should make insignificant information less distinct while reinforcing the main contents with bold lines, complementary colors, page distance, pictures used in representing alphabets, and the adoption of fun and creative characters. As for the material design guideline, the media should focus on one story for individual use. Students should also learn through playing, repeated reading, writing practice, using materials repeatedly without being bored, and can memorize the lessons when participating in hands-on activities.

Keywords: graphic design, learning material, children with learning disabilities (LD children)

1. Introduction

Education is essential for everyone since humans can spend all their lives learning about different things without an end. That can be something academic or typical knowledge found in our everyday lives. The knowledge acquired is used in our daily living, enabling us to use such skills in the jobs we do and build opportunities to lead to one's success. Education is important no matter which point we are in our lives. Nevertheless, the milestone that can significantly affect one's intelligence and often determine that person's talents is in their childhood. Firstborn babies learn and develop from their parents' teaching. Therefore, caring for a child is a crucial factor for a baby to have good development. Though the child may be normal and have good development, their development can be affected if parenting is not good. In the opposite case, although the child's development may not be good when they were first born, good parenting can also encourage their development (Losatiankit, 2017).

For this reason, the use of learning material or media should be selected to suit their needs since the materials can enhance the development of a child, such as storybooks or toys. In contradiction, inappropriate selection of the media used can endanger their development intelligently. For instance, a 2-year-old child who is allowed to watch IT media. Such a scenario has recently become more common and has contributed to the problems in children's language development (Losatiankit, 2017). Based on a survey conducted by the Department of Mental Health in 2017, it was found that the average IQ of Thai youth at the age between 6-15 years old is at 98.59, which is below international standard. The scenario reflects a problem that takes place in Thai youths. Accordingly, there is a need for precautions and remedies to the problems, as well as investigations that would bring forth guidelines in enhancing the quality and efficiency of Thai youths, who are of significant value to this nation. The guidelines should also allow them to be intelligent in both their IQ and EQ, not below average. Based on a survey exploring Thai students' IQ, it was found that 17 provinces in the North-Eastern part of Thailand consist of the largest numbers of students encountering IQ issues. Once the results were compared based on educational levels, it was revealed that students in higher education have the highest IQ. In contrast, students in fundamental education level have the lowest IQ (Department of Mental Health, 2016). It can be seen that how a child is being cared for and which educational institution they go to are factors that directly affect children's intelligence. Various reasons can trigger the cause of such a phenomenon. One of the reasons is the child's learning disability, which is one of nine educational disabilities: intellectual disability, hearing impairment/ deafness, visual impairment/ blindness, physical or health impairment, speech or language impairment, behavioral or emotional disturbance, learning disability (LD), multiple disabilities, and autism spectrum disorder (ASD). As stipulated by the Ministry of Education, children with learning disabilities or 'LD children' refer to children who cannot accomplish academically (due to disability), though they possess sufficient potential. The disability, however, is not of physical—such as visual or hearing impairment. The children who fall into this category are considered to have difficulties in learning, such as reading, writing, calculating, speaking, communicating, using language, or using muscles in movements (Chatkhum, 2000). Today, in grade 1-2 alone, over 700,000 Thai students could not read or write according to their ages, although they have normal IQs. Such is a commonly found condition of children with learning disabilities. The disability cannot be cured, but it can be treated to enhance one's conditions through their practice in a learning environment that is accommodated to LD children, allowing them to improve each aspect of their learning. Nevertheless, teaching techniques have to be specific to provide an appropriate remedy to children with special needs. LD children can be categorized according to the cause of the condition. 'Type 1 LD children' can be referred to children suffering from brain injuring, while type 2 LD children's learning disabilities are caused by genetics. Type 3 LD children's disabilities stem from the environment—an incident that happens after their birth. It could be that the children are raised in a high-risk environment. For example, receiving substance after birth due to polluted environment, malnourishment, and a childhood where children did not receive efficient teaching from the teachers, including lack of educational opportunities.

Though these environmental causes may not be the main factor that directly triggers the learning disabilities, these causes may deteriorate or worsen the existing disabilities (Ariyawinyu, 1999). Since early childhood, children with learning disabilities caused by environmental issues tend to improve their grades from proper and attentive care. Teaching with learning materials that focused on specific learning disabilities is using audiobooks with children who have difficulty reading or organizing an activity that corresponds to children's talents.

Providing materials and learning assistance by introducing various forms of modern technology designed based on the potential, interests, and needs of LD children's learning on different aspects is another way to remedy the child's development. Thus, materials or media are like channels through which knowledge is transferred from teachers to students to create a mutual understanding, making the teaching and learning more effective. Therefore, the materials are designed based on concepts and educational theories to suit each age group. 'Information processing theory' is a theory emphasizing the development process of human intelligence concerning the working of one's brain. It could help LD children to receive or acquire information/ knowledge systematically Klausmeier (1985) explains human learning that the brain's working is similar to how a computer process. The process includes the following steps: data reception, encryption, and data export. Humans take in information through five senses. The data received will be recorded depending on two elements: recognition (knowing) and interest (attention). Different steps and techniques are needed for the data to be stored and help them recognize the information. For example, word grouping, repeated recitation, and repeated writing. Scholars use the idea to design teaching and learning materials that focus on developing human intelligence from such a process. For the data to be recorded, one's recognition and attention are required. Therefore, the design of teaching techniques that are fun will draw attention from the children. Similarly, materials that are appealing coupling with fun techniques will be able to draw students' interests in learning. The learning materials use appealing pictures, colors, fonts, and layouts. These elements can be called the 'Rek-ka-sin' element (in Thai). However, today the word uses English transliteration as in the element of 'graphic design.' The principle of graphic design adopted in teaching materials will make the materials more appealing and eye-catching, as well as relay information or knowledge to children with learning disabilities with clarity. A good graphic design systemizes contents and information, making it more concise and clearer, contributing to quick information or knowledge transfer. An effective graphic design should be made in accordance with the end-users' age—comprises pictures, colors, and layouts that would be admired by the target audiences. Since the elements will affect the audiences' interest, the capability to recognize and draw their interest, making them more focused on learning for a longer period of time.

From rational and significance of the problems, coupling with a soaring number of children with learning disabilities, especially in Isaan region, by placing importance on graphic design to be adopted in learning materials based on the preference and interests of LD children, this paper on 'Graphic design for children with learning disabilities based on the Isaan mural painting' was conceived. The paper aims to investigate LD children in the Isaan region and formulate a graphic design guideline for learning materials that focus on LD children. It is hoped that the formulated guideline would assist teachers and parents with LD children to provide effective care of those LDs under their care.

2. Research Objectives

1. To study LD children in the Isaan region
2. To formulate a guideline of graphic design for learning materials that focus on LD children.

3. Related Literatures and Studies

With the importance of increasing of children with learning disabilities problems in the northeast region. The researcher, therefore, conducted research and investigated related studies. Began with the knowledge of learning disabilities by Arayawinyu (1999) said that the definition of learning disabilities

children is widely accepted and used are from US Department of Education and National Joint Committee on Learning Disabilities (NJCLD) which defines a learning disability is a term of an abnormality of various aspects which obviously appear to difficulties in listening, speaking, reading, writing, reasoning and math ability. This abnormality is occasionally occurring in the child from main cause from an impaired central nervous system and some can might be last for the rest of their lives. In addition, persons with such disabilities may exhibit disorganization, and social skills disability Chatkup (2000) demonstrate the types and characteristics of learning disabilities that in the past, learning disabilities were referred to academic skill disorders because learners who encountered with learning disabilities were less likely to catch up with their peers, included academic skill in classes may be stay behind in reading, writing or calculation skills. The learning disability types can be divided into four types as follows: 1. Reading disorder, 2. Writing expression disorder, 3. Mathematics disorder, and 4. Learning disorder not otherwise specified). At present, the reading and writing disabilities are the most common as aforementioned types.

The main cause of learning disabilities are from the environment after delivery: since parenting, support and promote education appropriately, In analyzing livelihood information of children with learning disabilities The Researchers studied functionalism structure theory, which Parsons (1978) explained that society is a system and In this social system there are functional features and made into groups and to meet the needs in the needs in the system, such as the social system, the need for someone to raise children entails to establish group for taking care of the young children for both families and schools, etc. When studying the roles and duties of who involved with children with learning disabilities, learning and educational materials to help children must be designed and developed to be appropriately for children with learning disabilities for development. In designing media, the researcher had studied from educational conceptual and theories to ensemble in in each stage of life. Information processing theory is a theory that focuses on the development of human intelligence concerning in brain function which can help children with learning disabilities receive information and knowledge systematically. Klausmeier (1985) described in human learning that the brain processing is similar to computer which work step by step: receiving data, encoding, and exporting data. When humans receive information through all five senses, when incoming information is stored in memory depending on two components: recognition and interest in the process of storing the information in memory. In the stage of storing memory, it is imperative to use mnemonics techniques such as word grouping, repetition, and repetitive writing. From this study the researcher can use this process as a framework for designing teaching methods and designing media which focuses on cognitive development process. The data storing as a memory requires recognition and interest. Therefore, designing fun teaching techniques might catch the child's attention. The beautiful media at the and amusing features will attract children to learn as well. The interesting learning materials will consist of pictures, colors, text and various compositions for beautifulness which also known as graphic design in nowadays.

Employing graphic design principles in teaching materials will help to create media with beautiful, attractive and able to transfer knowledge distinctively to children with learning disabilities. Good graphic design in teaching materials will help to organize the information concisely and facilitate information or knowledge transmission system with rapid and concise. The good graphics must adhere to the target audience with pictures, colors, compositions, the design is affected the interest of the audiences or even attract audiences who use media to concentrate on their studies for a longer time. Saichompoo (1999) mentions that the advancement in technology and the development of education entails to the changes of teaching methods. The learning materials or teaching materials are developed to be able to be used in teaching and learning to be the most effective. The modern equipment can help to speed up the learning time of the students to be fast and easy to understand with fun and stimulate curiosity to continue to study which students can learn by themselves by using new technology materials to develop and solve the problem of learning disabilities of children in 12th National Economic and Social Development Plan 2017-2021 (Department of Provincial Administration, Ministry of Defense, 2015). To correspond with strategy 4.1: Strengthening and developing human

capital capabilities due to Thailand's human capital still has problems in quality in each age group.

The educational outcomes from children's school are different from the development of knowledge and skills in the personnel not correspond with the job market. A large number of Thais are still unable to screen and opt in culture appropriately resulted in a crisis of values, attitudes and behaviors. In the next stage, the development needs to focus on foundation of development in people to provide good attitude and behavior in Thai people according to good social norms. Additionally, to provide high-quality education with international standards and allow learner to be able to learn effectively with better health conditions to promote all ages life skills, knowledge and abilities as well as strengthening social institutions and participation in national development based on the Basic Education Core Curriculum 2008 (B.E.2551) which was prepared for local and educational institutions to use as a framework and prepare educational institutions curriculum in teaching and learning for develop all Thai children and youth at the basic education level to gain quality of knowledge and necessary skill to live in a changing society, seek knowledge to develop oneself continuously throughout life (Office of the Higher Education Commission, 2010). In this study the researcher analyzes related studies and synthesis to be a framework for conducting research with the main objectives to study outcomes and create a guideline for graphic design and educational materials for children with learning disabilities.

4. Research Methodology

The study on 'Graphic design for children with learning disabilities based on the Isaan mural painting' aims to investigate into LD children in Isaan to formulate a guideline that is to be used in graphic design for the learning materials for LD children. The research was conducted qualitatively with a specified study area of 'Education Opportunity Expansion School. It is within Nakhonratchasima Primary Education Service Area 2, where the largest number of LD primary students are found in the Isaan region. The study target groups can be divided into three groups. First group comprises of three selected experts—experts on educational policy and experts on LD children. The second group comprises six practitioners from two schools. The third group includes a total of 279 stakeholders, who are divided into two sub-groups. The first sub-group comprises 270 primary teachers selected by purposive sampling. The targets will be interviewed on the current condition and existing issues concerning LD children in Isaan. The second sub-group comprises three teachers who teach LD students, including six parents with LD children. The group, selected by purposive sampling, will participate in in-depth interviews and provide information concerning LD children's behaviors. The instruments employed during this phase of the study are unstructured and structured interviews. The author used unstructured interviews in in-depth interviews where informants, who are experts, provide answers in an open-ended question. Structured interviews are interviews where questions are clearly defined to specify the information needed from both sub-groups of the stakeholders—270 primary teachers in Isaan and nine teachers and parents who care for LD children. Instruments for six practitioners consisted of 2 types of instruments: 1.) Non-participant Observation and 2.) Graphic design element test. The 'non-participant observation' is employed to observe classroom behaviors where pictures are taken without showing the faces of LD children and while an observer takes note. The second instrument, a test on the graphic design element affecting the audiences' reception and recognition of information, is used to test the students' interest and attention due to graphic design in learning materials. After that, all data collected from literature and field surveys are analyzed based on 'structural-functional theory,' 'information processing theory,' and 'principle of graphic design elements.' The interpreted data are then classified and synthesized before being formulated into the graphic design of learning material guidelines for LD children. The results are presented using descriptive analysis with illustrations.

5. Study Results

5.1 Results on LD Children in Isaan

5.1.1 Results of preliminary analyzed data of LD children in Isaan

From reviewing literature and related papers, it was identified that Isaan's cause for learning disabilities covers three reasons: brain injuries, genetics, and the environment. The first two reasons, which are brain injuries and genetics, cannot be cured for physical and neurotic disorders cause them. On the other hand, the third learning disorder is caused by environmental factors after birth. For example, intaking pollution from the surrounding environment, nutrition deficiency, ineffective teaching in childhood, lack of educational opportunities, lack of learning materials that encourage development, lack of appropriate care from parents, etc. These reasons can slow down the child's learning and can later be developed into feigned learning disorder or feigned LD. This type of LD triggered by the environment can be improved and cured through attentive caring from teachers and parents, teaching focused on a specific disability, including appropriate learning materials. Studies on learning disorders of different ages can be divided into four ranges of age: pre-school, elementary, high-school, and adult. It was found that LD children during their elementary are the best age range where their development can be evaluated, and where the disorder is most explicit for it is the time where learning starts. If it is found that slow learning or learning disorders are caused by environmental factors, teaching and learning with special techniques coupling with learning materials that encourage specific learning would promote the child's development to be better. The child will then be able to further their studies in high school and complete all basic education programs as required by the Ministry of Education policy. Studies on types of learning disorders can be classified into four aspects: reading disability, writing disability, math disability, and unidentified learning disability. From the data analysis, it is found that reading disability will also affect writing disability because if a child cannot read or spell a word, neither will that child be able to write the word. These two disabilities also take a toll on other subjects that it leads to math disability and others. Therefore, at the beginning of a semester, children should be screened. And if a teacher found a child with slow development or might be at risk or show some slight symptoms with no severe condition, all stakeholders, both parents and the teachers, should encourage appropriate learning to help improve the child's development. Nevertheless, this should be handled before it leads to other disabilities, affecting their high school learning where emotional and social conditions would, even more, complicate the disability. Once the condition reaches that point, the disorder will be challenging to be treated. Therefore, reading and writing disabilities are crucial and should be fixed as early as possible.

By analyzing numbers of LD children in Isaan, it was found that the 'Special Education Bureau' under the Ministry of Education is responsible for special education. The bureau carries out educational management focused on nine types of people with learning disability and learning underprivileged persons: intellectual disability, hearing impairment/ deafness, visual impairment/ blindness, physical or health impairment, speech or language impairment, behavioral or emotional disturbance, learning disability (LD), multiple disabilities, and autism spectrum disorder (ASD).

Special Education Bureau supports and collaborates with educational institutions in managing education for disabled persons in schools. They also evaluate and report study results to a committee to formulate a budget plan and request sufficient assistance provision. Therefore, submitting data to the information system of the Special Education Bureau is essential. The system which manages information transfer is called SET (Special Education Technology). It aims for teachers responsible for screening the students, school directors, and all education service areas to submit numbers of children with learning disabilities to the SET system. It allows the Special Education Bureau to formulate an effective plan in providing supports. According to the data retrieved from the SET system from the academic year of 2018, it was revealed that within Nakhonratchasima Primary Education Service Office

Area 2 alone, there are 3,537 students with learning disabilities from 147 schools. This means that each school has an average of 24 LD students. Compared to other Primary Education Service Offices in Isaan, Nakhonratchasima Primary Education Service Office Area 2 has the highest LD students. Thus, the area is selected as the study area, as in the following objectives.

5.1.2 Current status and guideline in aiding LD children in Isaan

Structured interviews were used by the author to retrieve information on the current situation, detected issues, and needs for assisting LD students in Isaan. The author conducted interviews with 270 primary teachers who were selected through purposive sampling in Isaan. The data were collected at the 'Producing Creative Learning Materials for the Learning Development of Primary Student Training' project at Kittrong Vill Resort in Ubon Ratchathani Province on June 30th, 2018. Information collected during interviews can be summarized into 4 points as in the following.

- 1) General information on all 270 respondents who are teachers: All teachers are primary teachers, but only 70 of them are certified by the Ministry of Education, authorizing them in screening students.
- 2) Learning issues of LD students: Mostly, in a class, there will be 1-2 LD students. And in schools taught by the respondents, at least one teacher with screening certification is stationed at the school. As per the most common LDs identified by the teachers are reading and writing disabilities. The number one factor for the cause of LD is the environmental factor, followed by LD caused by genetics. From the teachers' views, essential elements that would contribute to LD students' development are appropriate learning materials and resources, as well as qualified teachers. In most schools, supplementary classes are given to LD students after school or during lunch. By this, schools typically receive adequate cooperation from the parents. Based on the interviews, most respondents with experienced LD students who had their conditions improved and further their education at a higher level.
- 3) Policy and learning aids for LD students: Most schools receive sufficient budget and school executives recognize the importance of solving the issues. Also, the majority of the teachers do have learning materials for LD students. However, numbers of the learning materials are still insufficient for the needs. Some schools received a few supports regarding LD student teaching, while some have never received any form of aid from the outside units or offices.
- 4) Needs for LD students' learning supports: Class teachers and school executives provide most of the learning materials. Learning materials required by the majority of the teachers are skill toys and products. And items that would support LD students' learning are the internet, computers, television screens, including school's resources, which could enhance students learning, such as the library and play yard for activities. A great extent of schools has all the mentioned resources sufficiently.

During the field survey, the author interviewed three experts using unstructured interviews. The numbers of LD children whose conditions are caused by their environment are currently increasing from the collected data. Most of them have difficulty learning or were slower learners before, and the numbers are climbing every academic year. It is possible that this group of children is suffering from feigned LD since their grades can be improved through practice and received support or assistance. Such a case is different from children whose LD is caused by brain injuries or genetics, where the conditions are incurable.

Additionally, considering the children's families' living conditions in Isaan's remote area, it was found that most of the children are studying in educational extension schools. Their living conditions range from middle-class to poor. Many children live with illiterate grandparents, preventing them from receiving suitable supports in their education. Though these are not the root causes, it contributes to slow learning, slow reading, or writing, and eventually leads to more severe learning disabilities. In this regard, the Special Education Bureau is a unit overseeing children with learning disabilities, one of the

nine types of persons with educational disabilities designated by the Ministry of Education. Preliminary supports provided by the Special Education Bureau are educating and training teachers before they can obtain a license certifying they are authorized to screen for children with special needs. The bureau's tasks include educating mentors and sending out these trained mentors to schools where LD students are studying. Such is to reduce workload from the main teachers. The bureau also provides budget and 2,000-baht-learning-material coupons for persons with an educational disability. For the person to receive those, the required documentation must be submitted in the system. The request will be granted as budget or ready-made learning materials listed in the bureau's material handbook. Special Education Committee is the one who selected all materials that appeared on the list. The collected materials on the list include traditional materials that can be adapted for LD students' use and those made especially for LD children. Yet, the materials' appearances are not appealing enough for the children to fully concentrate on using it. Additionally, the procedure in requesting for learning-material-coupon for LDs is too redundant that it takes a very long time. By the time the materials arrive, the students would already complete the lessons in that semester. Materials customized made for learning disability should be appealing, eye-catching, able to stimulate LD students' interests, easy to find, accessible, harmless to children, and can be used or carried anywhere at any time. This way, the school would be able to prepare those as the school's basic materials ready for use. Once a teacher detects any delayed learning or disabilities in a child, the teacher can use those materials right away. The said materials would be an excellent source for learning and ought to be supported. Also, aids from hospitals located in the same educational jurisdiction are vital to LD students. The reason is that the hospitals will be able to take care of the pupils, evaluate their IQs, and provide parents with the correct advice on caring for their LD children.

5.1.3 Behaviors of LD Children in Isaan

On the field, the author conducted structured- interviews with teachers and parents with LD children. It was found that the collected information is consistent with analyzed results concerning classifications of learning disabilities. LD children's conditions are likely to be explicit during their primary education, approximately between grades 1-3. The conditions shown include the inability to recognize alphabets, spell out words, pronounce words, pronounce tonal marks. Such can lead to writing difficulties that eventually cause other learning disabilities in different subjects. In some cases, the child may have ADHD (Attention Deficit Hyperactivity Disorder). In this case, the student would have a short span of attention, lack observation skills, be interested in multimedia materials but cannot remember or focus on the lessons' contents. They also admire entertaining learning games that are used to introduce them to the subjects. Once they are home, LD children without close attention from parents or living with parents who lack understanding will not do their homework or study. The incidents would only worsen their conditions. Therefore, both teachers and parents agree that the needed materials should be available in schools. The materials ought to encourage learning in students, especially LD students; it should be easy to obtain, user friendly, and can be often used by the students. Today, the primary materials for LD children in schools are provided by the Special Education Bureau and from the schools' requests using the learning-material coupons for LD students.

As mentioned, it can be summarized that learning materials suitable for use should be supervised by teachers who specialized in LD; at the same time, students should also be closely evaluated. It is also agreed that it would be more appropriate to place the schools' materials, not at home. Parents often lack knowledge concerning LD; neither do they have time to use the materials. The learning materials teachers need were the ones which can be used several times, can be handled by the students on their own, and must not be complicated for one to use. For example, the materials that require a high-quality computer need an internet signal, or need to be used with electrical appliances that are difficult to handle. Also, multimedia roles should be reduced since the children will be at risk of being addicted to IT media and not paying enough attention to reading or writing.

Regarding investigation into LD students' classroom behaviors, the author went to the site to

observe 'in-class behavior' and 'material-use behavior' of the targeted LD children studying in Educational Opportunity Expansion schools within the educational jurisdiction of Nakhonratchasima Primary Education Service Area 2. The non-participant observation was employed. The observation is an educational tool that was designed based on Klausmeier's Information Processing theory. The observation revealed that most in-class behaviors of LD students show that they are attentive to the teachers' teaching. However, they did not follow the teacher's instructions during activities. Some show signs of anxiety when they are with friends or when they're talking to strangers. In some cases, the LD child would be avoidant, does not speak to friends, is interested in colorful pictures but does not understand its contents. Others do not read or speak when it is required of them according to the material's instructions. From the obtained data, learning material for LD children should be made for individual use, not for students' participation in front of the class. Students should be able to watch and do activities in the materials on their own. The materials should also require students' actions to draw their attention, such as opening, unbinding, or writing. Illustrations should not be overload with details or full of too many colors on the page. The contents should not be complicated; it should also require them to write often to practice their muscles and encourage them to memorize alphabets and vowels.

5.1.4 *Graphic Design Elements of Learning Material Affecting Brain Information Processing in LD Children*

To test how the graphic design elements affect the brain information processing of LD children, the target group took the test at the site. The test was based on Klausmeier's Information Processing Theory. According to the theory, knowledge can be created into short term memory and short-term memory into long-term memory by adopting the 'sensory registry process.' The process, though, should be coupled with attention, care, and key elements of graphic design for literature. The results can then be used to formulate guidelines in future learning material designs.

From the test on effects of graphic design elements on 'attention'—ability to draw LD children's interest to be focused on the learning materials—it was revealed that most targeted LD children chose the drawings or characters with 'super-deformed' attribute. Super deformed characters are cute and out-of-proportioned cartoon characters. Some may have big heads with tiny torsos. The drawing's proportions are unrealistic and often use bold lines with bright colors to make the picture stand out. Also, analogous colors and complementary colors are used to emphasize key points in the lesson. The layouts should have different dimensions and forms for them to memorize. Regarding the drawing's placement, essential topics that need emphasis should be placed in front and the middle of the page. The last graphic design element is that the alphabets must be clear, and drawings should be used to symbolize the alphabets. By this, children will be able to catch up on their writing without any confusion.

From the test on the effects of graphic design elements on 'attention,' which can make LD students learn, understand, and remember contents on the learning materials, the following was discovered. It was found that LD learners could remember the key point from a drawing that stands out from the page. The drawing they remembered uses bold and bright-color lines. Complementary colors were used to make the drawing stand out, while analogous colors were applied only to decorate the picture, making it more appealing. Images or contents that need no emphasis, its lines and colors should be less stand out. Such is to prevent a student's incorrect focus. Regarding the layout or position of the drawing, placing the drawing in front and in the middle of the page will help students remember the key points more quickly. In light of alphabet memorization, if a symbol is used to represent an alphabet and pronunciation, the children will remember. They will be able to write according to what they recognize in the symbol used—for example, using cockscomb to decorate the alphabet 'Kor Kai' in Thai, whereas hen's beak is used to symbolize the alphabet. The students then learn what 'Kor Kai' looks like.

5.2 Results on Formulating Guideline on Graphic Design for LD Children's Learning Material

The obtained data are employed to create the following concept on graphic design and learning materials for LD students, as in the following.

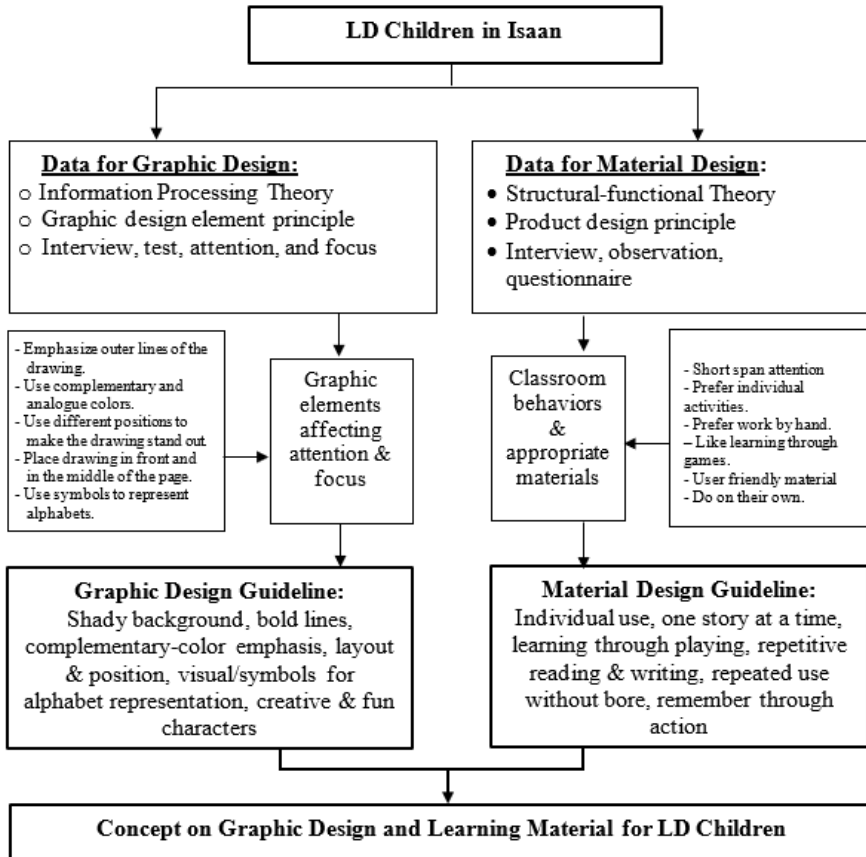


Figure 1. Concept on Graphic Design and Learning Material for LD Children

Based on the data from the study of LD children in Isaan, the guideline for graphic design and learning material for LD children can be synthesized as in the diagram above. The author created the chart on graphic design and learning material for LD children based on two elements. The first element is 'data for graphic design,' which covers Information Processing Theory, Graphic design element principle, including collected data from interviews and tests for attention and focus. The obtained data were then synthesized into a graphic design guideline and shady background, bold lines, complementary-color emphasis, layout & position, visual/symbols for alphabet representation, creative & fun characters. The guideline principles are explained according to its importance, respectively. **Shady background** means to reduce clarity, use the size of drawing lines, color, and layout to not make the background stand out. This would allow students not to shift their focus from the main contents. **Bold line** means to increase the size of the drawing lines, showing clear contrast between the drawing and background, use complementary color in the place where the focus needs to be, and position the drawing in front and the middle of the page. **Complementary-color emphasis** means using a complementary color to

create a distinction to the drawing. **Layout & position** refers to the importance of structure and position that is applied to the drawing to make it practical for students to remember the contents. **Visual/symbols for alphabet representation** mean using symbols to make it easy for the students to remember the alphabet. **Creative and fun characters** indicate that the drawing's proportions should be unique, innovative, and memorable as samples below. The illustrations below are materials used in teaching students the Thai alphabet 'Kor Kai.' It shows differences between two graphic designs for LD students versus regular students.

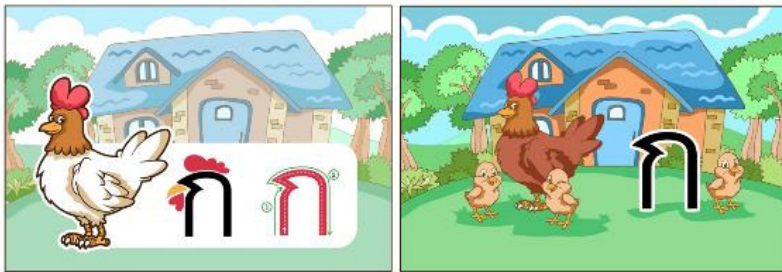


Fig.: A picture (left) is graphic design for LD students, while another image (right) is graphic design for regular students used in teaching Thai alphabet 'Kor Kai' during Thai class.

The second element is 'data for material design.' This includes structural-functional theory, product design principle, and data collected from interviews, observations, and questionnaires. The obtained data were then synthesized and created into a learning material design guideline focused on LD children. The guidelines are **individual use**, **one story at a time**, **learning through playing**, **repetitive reading & writing**, **repeated use without bore**, and **remember through action**, which can be explained in detail, respectively, according to its importance. **Individual use** refers to materials that are meant to be used individually, not in a group. **One story at a time** means that the design of the materials must not be complicated. Steps should be clearly explained, regardless of what content in the lesson may be. It should not confuse the users of the materials. **Learning through playing** means that the material should be designed as if the children are playing games, while the material incorporates knowledge into the game when they are playing. **Repetitive reading and writing** mean that the material was designed to repeat writing and reading until they can remember the lessons. **Repeated use without bore** means that the materials can be repeatedly used for several times. And **remember through action** implies that children should be able to touch, open, pull, or have any other interactions with the materials. This ensures that the children's attention will be drawn to the material, making them stay focused for as long as possible. Below are examples of the materials designed by the author.



Fig.: Examples of math learning material for LD students: Erasable pens are provided so that the material can be reused. Stories and puzzles are also incorporated into the materials, allowing them to have fun while using the media.

Both mentioned guidelines are learning material graphic design concepts for LD children. It contributes from data collected from the field, which delves into the interests, needs, and preferences of the children with learning disabilities. Thus, these materials can pose effects on children's attention, enabling them to concentrate on the materials, obtain information from the lessons, and remember the lesson's contents. Such material has helped improve the children's conditions due to their disabilities once they use it regularly.

6. Discussion

From the study conducted on LD students in Isaan, it was found that, concerning their social and family conditions, most of the children did not live with their parents. This is because their parents need to work in other provinces. Then, the children were left with their relatives or grandparents who are often illiterate and do not have time to look after the children with proper care. Therefore, children, in this case, became addicted to IT media. Children started to experience problems in language development and become indifferent to review their lessons. Such issues contributed to more severe cases of learning disabilities that it became incurable. Such is consistent with Structural-functional Theory developed by Talcott Parsons (1902 – 1979). Like a family whose members take care of one another, the theory believes that a society is a system consisting of parts related to and supported each other. Steady relationships of each part will create balance in the social system. However, should there be any social changes, the balance will also be destroyed. This is like having parents who need to work elsewhere, abandoning their responsibilities in taking care of the children to grandparents. Balance in the child, then, becomes broken that he refuses to do his roles. As Parson stated, once there is a change in one part, other parts change as well. The statement is also consistent with a paper 'An Enhancement of Family Roles of Educational Students, conducted by Panadda Yimsakul (2018) from Dhonburi Rajabhat University, Faculty of Education. The research concluded that family roles comprised of five elements: 1) family rules, 2) communications in the family, 3) developmental enhancement in the family, 4) love and bonding in the family, and 5) family stability.

From the formulation of the guideline in the graphic design of learning material for LD children, the guideline can be summarized as in the following: **individual use, one story at a time, learning through playing, repetitive reading & writing, repeated use without bore, remember through action.** 'Repetitive reading and writing' incorporated in the material means that the material should provide enough space for the children to repeat their writing until they can remember it. The idea of 'repetitive use' of the materials means that the material can be used several times until they understand the lesson. The technique corresponds with the 'Information Processing Theory' by Klausmeier (Klausmeier, 1985) in that once a piece of information is received, the data will be recorded as short-term memory. However, to store the data as long-term memories, different techniques are required, such as word grouping and memorizing. The methods are similar to how teachers teach LD children repetitively until they understand the lessons. The method is also in line with Natthiya Phukhamkhom's study (2009), which investigates the use of stories with pictures to enhance LD students' reading comprehension ability. The study had the students read children's stories that have beautiful images repetitively and found that after the reading, LD students gained better reading ability and comprehension before using the interventions.

7. Conclusion

7.1 Conclusion on Information of LD Children in Isaan

The main reason which causes learning disabilities in children in Isaan concerns with environmental factors. This kind of disability happens after birth. It was also found that the best age range to receive treatment or help is during primary education, where their conditions can be improved. Types of

disability that are found most often are reading and writing disabilities. Based on the SET system during the academic year of 2018, it was found that the educational jurisdiction with the highest rate of LD children is Nakhonratchasima Primary Education Service Area 2. In light of LD children's social and environment, it was revealed that most LD children do not live with their parents but stay with their relatives. The children, therefore, lack suitable supports in their education. In screening for LD children, collaborations are needed from parents, schools, Special Education Bureau, and hospitals. In regard to classroom behaviors of LD students, most children cannot read or write. Social disorders and difficulties in participating in classroom activities are also depicted in LD students. As for issues regarding LD students' learning enhancement, materials used do not respond to the children's specific needs. It seems that they require materials that are user friendly. Materials should be more focused on individual use, not classroom participation in front of the class. All multimedia should be avoided at all costs since it adversely affects the students' sight and concentration.

7.2 Conclusion on graphic design for learning materials for LD students.

In formulating the concept in the graphic design of learning materials for LD children, the author analyzed data from existing literature and data collected from the field using Structural-functional Theory, Information Processing Theory, product design principle, and graphic design element principle. Then, the analyzed data were synthesized and used in formulating guidelines in graphic design and material design. The graphic design guideline requires that the design is to have the following attributes: shady background, bold lines, complementary-color emphasis, layout & position, visual/symbols for alphabet representation, creative & fun characters. At the same time, material design guidelines should be applying the following principles: individual use, one story at a time, learning through playing, repetitive reading & writing, repeated use without bore, remember through action.

8. Recommendations

8.1 Recommendations for Application of Study Results

The study on graphic and material design guidelines for LD students is a study to search for principle technique in design learning materials that would help enhance LD students' development. Therefore, its study results should be maximized as follow:

1. Used as a guideline for graphic and learning material design for LD children.
2. Used as a new body of knowledge for both governmental and private organizations to formulating development plans and policies that will accommodate to LD children in the future.

8.2 Recommendations for Further Studies

1. A further investigation should experiment with designing and learning material prototypes to test its efficiency.
2. A comparative study should be conducted to compare LD children from different areas. For example, LD children studying in provincial schools versus LD students in remote educational opportunities expansions schools.

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