INTERACTIVE 3D SHAPES EDUCATIONAL GAME FOR DYSLEXIA CHILDREN

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ABSTRACT

Dyslexia children are under the special category during their study. In fact, they are smart as normal children, but they cannot enjoy their learning process as them because of Dyslexia disorder. Therefore, this project is discussed about Interactive 3D Education Game, which is specially developed for Dyslexia children in order to provide them an adaptive and interactive education environment as well as allow them better understanding about shape's name and its properties. This educational game is divided into two main parts which are learning session and final challenge session. This method can help them understand their capabilities well. The main objective to develop this adaptive and interactive 3D education game is allowed Dyslexic children can be easy adapted into the learning environment. According to testing, this educational game is very effective to help Dyslexia children to learn 3D shape's name and its properties. They are attached to the learning environment while playing. Waterfall model approach ADDIE Model is used as a guideline to develop this educational game, which started with analysis phase, design phase, development phase, implementation phase and evaluation phase.

Keyword: 3D Interactive Educational Game, Shapes, Dyslexia

ABSTRAK

Kanak-kanak disleksia adalah di bawah kategori khas dalam kajian mereka. Malah, mereka pintar seperti kanak-kanak normal dan gangguan Disleksia telah menyebabkan mereka tidak dapat menikmati proses pembelajaran mereka. Oleh itu, projek ini adalah membincangkan Interaktif 3D Permainan dibangunkan khas untuk kanak-kanak Disleksia supaya dapat menyediakan mereka dengan persekitaran pendidikan yang sesuai dan interaktif untuk membenarkan mereka dapat mengenalkan nama bentuk dan sifat-sifatnya. Permainan 3D ini akan dibahagikan kepada dua bahagian utama iaitu sesi belajar dan sesi peringkat akhir. Kaedah ini dapat membantu mereka untuk memahami keupayaan mereka. Objektif utama untuk membangunkan penyesuaian dan 3D interaktif permainan pendidikan ini adalah membantu kanak-kanak Disleksia mudah menyesuaikan mereka sendiri ke dalam persekitaran pembelajaran. Menurut ujian dilakukan, permohonan ini adalah berkesan untuk membantu kanak-kanak Disleksia belajar nama bentuk dan sifat-sifatnya. Mereka dapat melekat dengan persekitaran pembelajaran semasa bermain. Pendekatan model Waterfall Model ADDIE digunakan sebagai panduan untuk membangunkan permainan pendidikan ini bermula dengan fasa analisis, fasa reka bentuk, fasa pembangunan, fasa perlaksanaan dan fasa penilaian.

Kata kunci: 3D Interaktif Permainan Pendidikan, Bentuk, Disleksia

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Education is defined as transmission knowledge from one generation to another with direct instruction such as teaching, training, or research. We are learning new knowledge, skills and habits from the seniors who have more experience than us. Education was existed in all society, no matter in the past or present days. However, learning new knowledge and skills from school is the mass education within this modern period. We frequently accepted the education under guidance from others, or self-education. Besides that, any experience that has a formative effect from thinks, feels, or acts also considered as education too. Education can be divided into several stages, which are pre-school, primary school, secondary school, college, university or apprenticeship [1].

However, there still have special cases that happened in the education field. Some of the students are difficultly to accept normal education and having problems in their learning process. While, wide varieties of learning problems can be concluded as learning disabilities or learning disorders (LD). However, they aren't lazy or silly; instead they are smart as others [2].

Differently brain neuron's connection and weak brain performances were causing them different from non-disorder children. These problems were given some impacts for them to receive, process, analyze and store information [3]. Thus, they cannot learn as quickly as normal children. It makes them difficult to learn new information

and skills. By the way, the processing process in our brain is extremely complex, so it is not weird case when the brain is messed up, what's more for learning disorder children.

Moreover, learning disorder can be classified into three major types, which are mild, moderate, and severe[4]. The intelligence quotient (IQ) scores for mild learning disorder [5] (MLD) normally in the range 50 – 70 after testing by standardized IQ tests. The performance of intelligence functioning for mild learning disorder is lower than normal children. This is reflected in a slow rate of maturation, reducing learning capacity and inadequate social adjustment. Besides that, they also have limitations in adaptive behaviors as well as expressed in conceptual, social and practical adaptive skills. The IQ scores for moderate learning disorder [6] normally in the range of 35 – 50. Developments for them are undermined, as well as learning ability for language and communication skills, social and personal development, movement coordination, basic literacy and numeracy, and independence skills. The range of IQ scores for severe learning disabilities [7] is in between 20 – 35. It can cause additional or multiple disabilities for a child, such as physical impairment, hearing impairment, visual impairment, cerebral palsy, autistic tendencies, emotional disturbance, sensory losses as well as the behavior problem.

The problems of learning disorder can be concluded into a few categories, which are spoken language, written language, arithmetic and reasoning[8]. For children who are facing spoken language, they will face listening and speaking problem. Weak in reading, writing, and spelling is considered in writing language category. Children who are in arithmetic category, will face problems in calculation and concepts. Last but not least, reasoning category is cannot organize or integrate their ideas and opinions as well.

A learning disorder has many types of disorders, which included autism, hyperactive, dyslexia, dyscalculia and others. However, this project mainly focuses on Dyslexia disorder children. Dyslexia disorder is one of the disorders from learning disabilities. Dyslexia is under category language-based learning disability[9] which is related to spoken language and written language. Most of the Dyslexia disorder children have problems in reading comprehension, fluency read out the article, word recognition, spelling, mathematics and etc[10] . Dyslexia is the most common disorder among all

types of learning disorder. In fact, Dyslexia children are intelligent as others' normal children; moreover, some of them are high in IQ[2]. However, they are labeled as lazy and dumb, because they are unable to write, read and calculate.

A child who is starting to learn, understand, and do things different than other children in the same age, most of them are suffering with learning disorders. In fact, Dyslexia is not a disease. Dyslexia is happening because of the abnormal neurological and hereditary condition[11]. The brain processing for Dyslexia is different than normal people. Based on the research, between five people had an individual is suffering from Dyslexia disorder[12]. Besides that, the difference performance of brain processing will give different effects. For example, hyperactive, autism, slow learner and etc. However, they can learn new knowledge and skills, but slower than normal children. Thus, the future development for a Dyslexia child will be influenced and this topic still remains a concern for public in present days.

Teacher based is the present method to give lessons to Dyslexia children. Therefore, this educational game is developed based on the Dyslexia child's requirements. Textbook syllabus and information will be referred to. Moreover, there still lack out of teaching software for teachers give lessons to Dyslexic children. So, this educational game will include suitable elements in order to meet the objective of this project. So, the aim of this project is to enhance the current teaching method. 3D method and game style is used in order to create an educational game in order to help Dyslexia children can receive their lesson well and allow them easier to adapt into the learning environment.

1.2 PROBLEM STATEMENT

Based on the research in the United States, there is one in five children has been learning disorder problem[12] and estimate that 17% of schoolchildren have Dyslexia symptoms[13]. Moreover, based on the research from England, there are 89% of children with moderate learning difficulties, 24% of children with severe learning difficulties and 18 % of children with profound multiple learning difficulties are educated in mainstream schools[14]. However, there are almost 80% from learning disorder is Dyslexia[2].

Dyslexia is the special name for one of learning disorders and normally gives impacts on reading. Dyslexia people always mislabeled as lazy and dumb. Yet, they are smart as normal people. Dyslexia is happened because of abnormal neurological and hereditary condition. Dyslexia people normally have problems in word recognition, reading comprehension, writing, spelling, mathematically, and etc. It might cause the change of the written material because of the wrong brain processing.

Dyslexia had many symptoms. However, it can be classified into 5 main major categories. Firstly, Dyslexia people will mix up the similar words. For example, they will wrongly to differentiate the letter 'b' and 'd'; words 'was' and 'saw'. Secondly are linear sequences' problems. They also will confuse anything that operating in linear sequences. For example, time table, alphabets and etc. They even cannot correctly to spell the word. They will spell the words reversely (was/saw), omissions (tip/trip), additions (slip/sip), substitutions (rip/rib), and transpositions (stop/pots). Thirdly is short term memory for Dyslexia people. They cannot memorize the information and knowledge for a long period. Fourthly is the problem of coordination. They might face the physical problems such as clumsiness, word pronunciations and etc. Last but not least is reading and writing problems. They are even hard to finish writing a word. In addition, some of them will leave off the grammatical ending too such as –s, -ing, and etc [15][16].

Most of the children have to take a lot of time and energy to commit the complicated task given by the school. Most of the parents started to realize their child is

different from others after they send their child to elementary school. In addition, they are hard to differentiated normal children and Dyslexia children because Dyslexia children don't have obvious symptoms to observe for. In addition, they also lack knowledge in this area and just treat them as normal children. Therefore, Dyslexia children always mislabeled as dumb and lazy if they cannot follow the lessons taught in class, difficult to learn new information and skills, hard to read and others problems. They have to always reply to doing the same lessons in order to familiar the new information or skills they learned. However, this might not a good method for them.

By the way, the current method that using in our country is teacher based. In fact, Dyslexia children are easier to lose their attention. A teacher based is difficult to attract their attention because lack out of interactive issues. So, they will lose their interest and didn't feel enjoyable with their learning process. They feel stressful and might refuse to go school. Computer software has proven to become one of the useful tools for Dyslexia children in their learning process. However, the existing systems and applications are using English as main language. Our country is multi-races and this also causes a problem for them who are using their own mother tongue as their usual language.

Thus, it can be a different situation with each of the children who are learning disorder. Moreover, each of the learning disorder children had their own patterns to learn, understand and do things. So, it is impossible to make same methods for different learning disorder children; instead, they have to understand the strength and weakness for giving the proper treatment for them.

1.3 OBJECTIVE OF STUDY

- To investigate Dyslexia children requirements in their learning process
- To develop the interactive and adaptive 3D shape educational game for Dyslexia children
- To test the functionality of the 3D software to Dyslexia children.

1.4 SCOPE

This project is about to create the 3D shape educational game for A learning disorder can be divided into few stages, and the main target audience for this educational game is mild, moderate and severe Dyslexia children who are within 5 to 9 years old. The existing system will be enhanced by the Dyslexia research that did. The main purpose of this educational game is to help Dyslexia children can easily adapt into their learning process. Unity and Autodesk Maya software will be used to develop this educational game in order to create the 3D object as well as animation effect. In fact, 3D model is more realistic than 2D drawing. In addition, animation function also added into 3D models, so they can view and observe that 3D model in 360 degrees. As the result, they can indirectly learn new knowledge about shape's name and its properties while playing the games.

1.5 REVIEW PREVIOUS WORK

This project is specially focused onto Dyslexia disorder. Dyslexia disorder, also known as a developmental reading disorder. Most of the Dyslexia disorder people will suffer in reading. They might not able to read a simple articles or words. They felt suffer and fear when in the task of reading, spelling and writing.

Information with previous product or existing systems do with the ways of researching, referencing, case studying, or other relevant findings for the product is processed in order to develop or create a new application and satisfy the Dyslexia disorder criteria. Some of the previous works were compared as below.

Wordshark[17]

Wordshark is a computer program that combines fun, excitement of bright, multi-sensory games. This game has more 10,000 words that were recorded initially. Moreover, the greatest benefit of this game is user can insert own words into this game. This game is presented in 2D form with animation effects. The main purpose of this game is improved the reading and spelling skills. This game is suitable for students who earn between 5 to 15 years old. They can learn new knowledge in fun ways without stress. They don't need to compete with non-learning disorder student too.

This wordshark game was included many single and simple words. Therefore, students can learn the words based on their capability. Moreover, most of the words were specially structured in order to help any level of Dyslexia. Besides that, this program also included some lessons for user to refresh what they had learned.

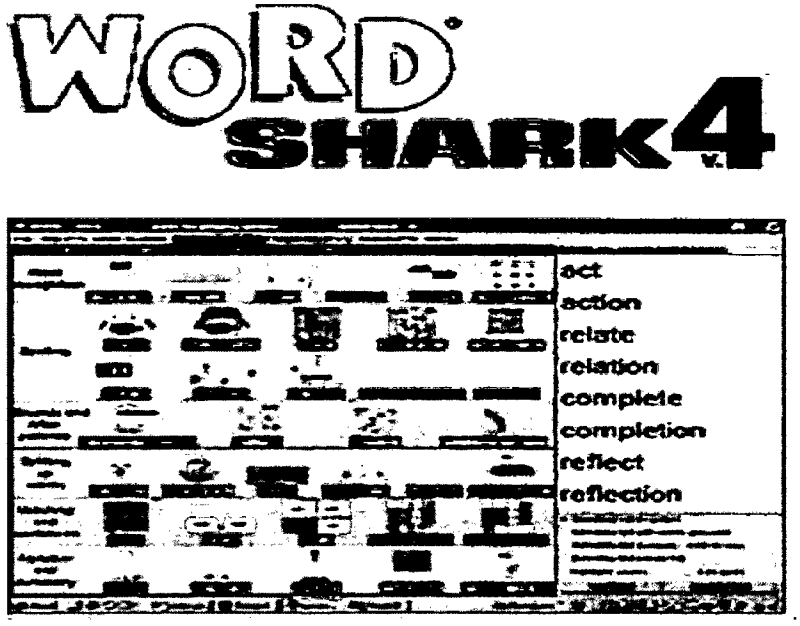

Figure 1: wordshark interface

Brainzy[18]

Brainzy is mathematics and reading program, especially for pre-school children, kindergarten and first grade students. It created in 2D and $2\frac{1}{2}$D with animation effects. In between, mathematics and reading skills are an important skill for a child. Children can learn in the way of the game challenge. So, they can always practice their mathematics and reading skills with variety fun games that can find in this game. Colorful and attractive background can attract child's attention as well as impressed with what they have learned.

This game is using the sight word method. The advantage of this method is memorable. Moreover, children will more interesting to study pictures than words. Moreover, those pictures game also mix with audio effect, sound matching exercises and story.

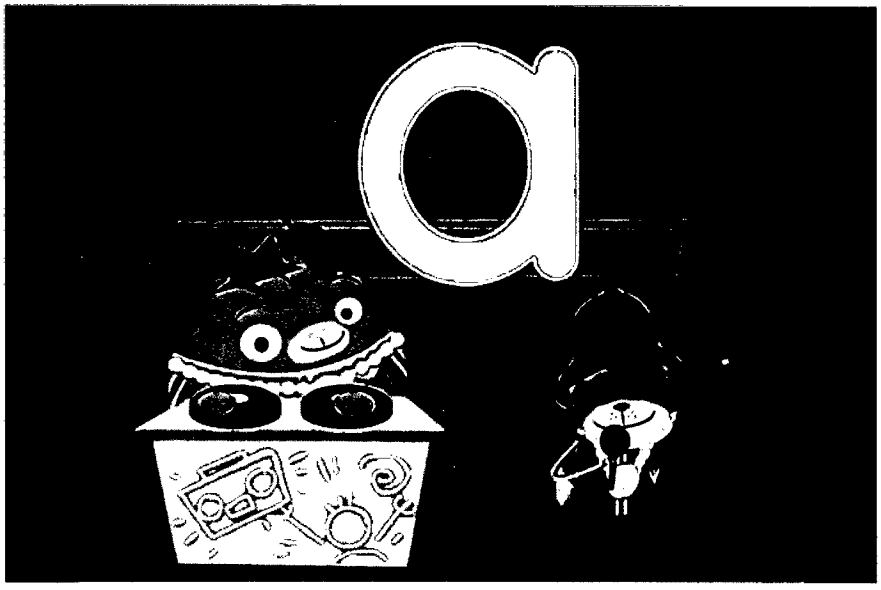

Figure 2: brainzy interface

Maths 3D shapes[19]

This is another 3D shape game. This game is online-based game. This game is suitable for 9 until 11 year olds children play. Moreover, the interface of this game is presented in $2\frac{1}{2}$D and 3D form. Besides that, this game has a few levels for user to challenge. User can have fun with played this game. They also can learn the new knowledge through this game such as the shape patterns, number of edges, vertices, as well as faces and etc. before start playing this game. Besides that, this game has different levels for user to play and become harder when going to the next level.

Animation and audio effect were making this game become more adaptive and interactive. Moreover, colorful background, objects and interfaces can attract the child's attention. The user can feel the nervousness because of the level challenging inside the game. For example, enemy robot will move nearer if the user cannot select the correct answer within the limited time.

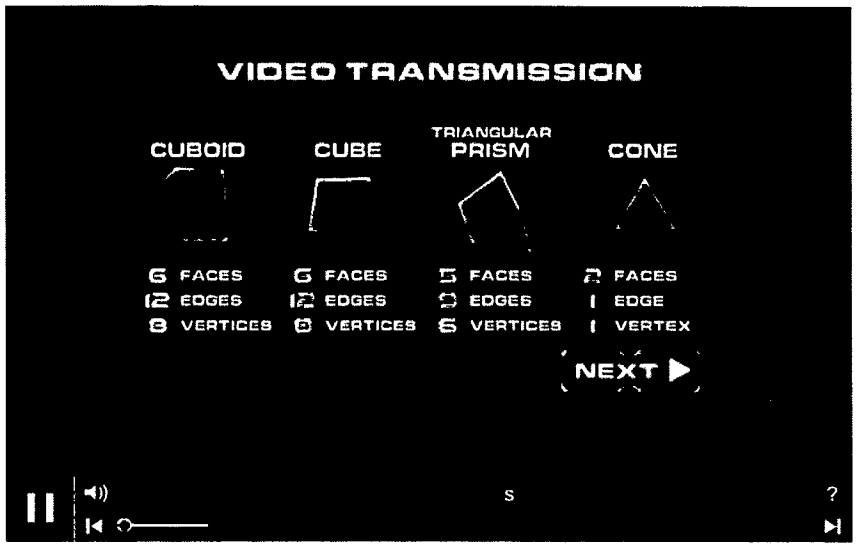

Figure 3: Maths 3D shapes

Kidzui[20][21]

Kidzui is an online education for special children, such as learning disabilities, autistic, and other special needs. This game is suitable for 3 until 12 year old children. They can learn, play, find and explore the game through the game browser. This is $2\frac{1}{2}$D and 3D game. There have many games in this system which included sports games, racing games, games for girls, puzzles and more. This system was packed with fun and educational games for children. Less words and colorful graphic background is the strength of this system. Besides that, user also can watch funniest, latest and hottest videos.

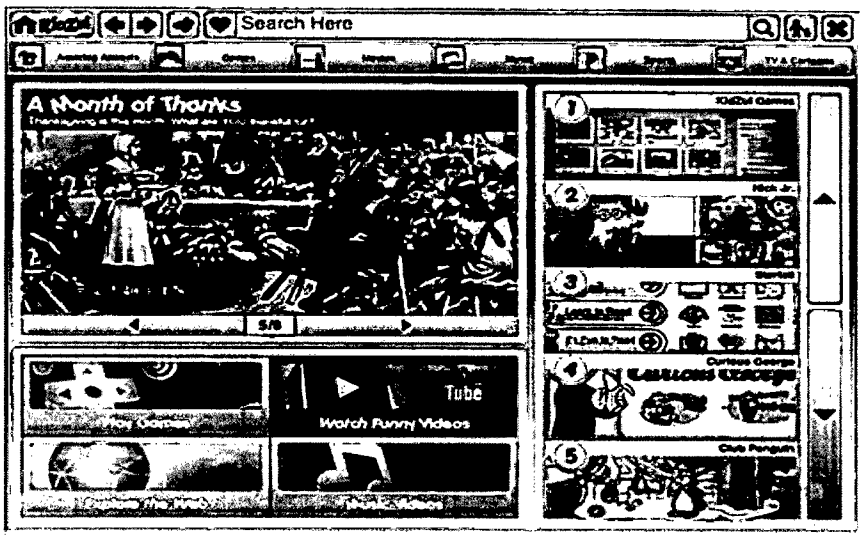

Figure 4: kidzui interface

Shape Splat[22]

This is a simple online 3D shape game. The user has to find the shape that same as the instruction given. This game has some useful features which can help Dyslexia children. An audio effect is the main components for this game. The user can know what shapes they should hit for next. Besides that, the mouse cursor is represented in word form. So user can refer back what shape they should hit if they forget the instruction given.

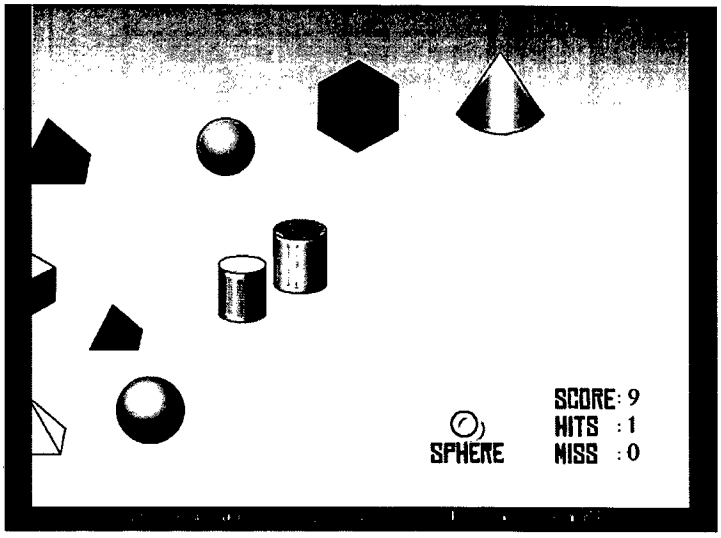

Figure 5: Shape splat

Dyslexia Game [23]

This is the manual ways for Dyslexia children. They can play those games through written. Dyslexia students will be trained by drawing in order to train their right brain to become more creative and expressive. Next, left brain also will be trained in the way of observing the previous lessons and completes the tasks given. The main task for left brain is analytical thinking. Thus, Dyslexia students will be trained with those contexts of art in order to strong the brain connections on the reading and writing tasks.

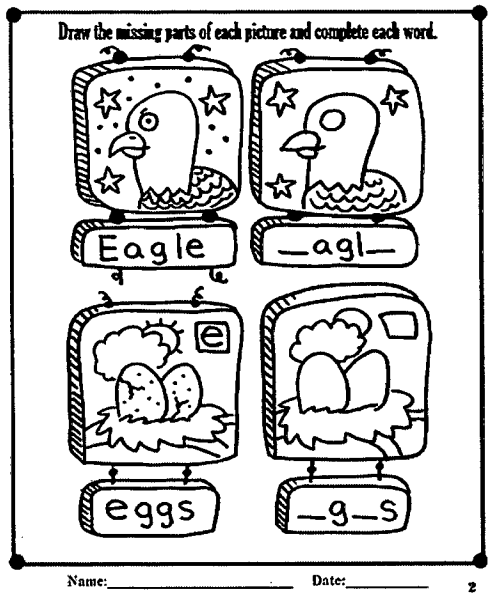

Figure 6: Example of Dyslexia game

1.6 CURRENT SYSTEM AND ITS LIMITATION

Although those games are suitable for Dyslexia children, but there still have some features that are not suitable for them. The main problem for Dyslexia children are suffering in word recognition, writing, spelling and mathematics. While, the common symptoms for them are mixing up the similar words and short term memory. They will look alphabet 'b' into 'd' and hard to memorize a new word, although they are learning it just now.

Thus, the game must be attractive, interactive and adaptive in order to attract their attention. Dyslexia children are faster to lose their focus because lack out of issue interactive. Simple 2D effects and audio effects cannot attract their attention for a long time. Although some of the systems have animation and 2D graphic effect on the selected word, however, it has not in line with the word meaning problems. In addition, audio effect also is an important component when creating a system or application for Dyslexia children. Although most of them are suffering in word recognition, but they can listen up the word pronunciations to understand the given instructions.

Moreover, some of the games have messy and complex interface. For example, the Kidzui online game system has a complex interface and many functional buttons such as YouTube, open new web browser and etc. This can cause Dyslexia children confused by the layout arrangement. They have to spend time to learn how to use this program before playing and confused about the given lessons. This condition can be happened because of unsure the lessons that suitable for them.

Besides that, some of the shapes games are displayed in a static 3D form. User can't clearly observe what the shape patterns are represented. It is because those shapes can't rotate or move it in 360° degree. They can't observe the backside of the shape. For example, the shapes in game Shape Splat are moving in static way and those shapes cannot rotate in 360° degree. Reading word form instructions is a difficult job for Dyslexia students. However, word form instructions can be insteaded with video form demonstration. They can easier to understand what they should do for the next step after watching the video. So, video is an important element to build an adaptive and

interactive game. However, most of the current game didn't consider this issue within their game.

Based on the previous work research, there have some limitation of the current system and application. The most famous way in our country is written using pen and paper, although there has a lot of Dyslexia game in the market nowadays. However, Dyslexia students are easier to lose their attention and focus if they feel this game is bored to play. Written on paper cannot always focus their attention because of lack out issue interactive. Moreover, our country is multi-racial nation, so we cannot use one language to represent the game. All those games that described before is using English as the main language. However, most of the children didn't have deep cognition of English and they are more familiar with their mother tongue. So, there have a lot of games that are hard to play with Dyslexia disorder children.

1.7 TERMINOLOGY

3D[24][25] – 3D is meant three-dimensional, which include width, height and depth (length) or represent as x (horizontal), y (vertical) and z (depth).

Education[1] – education is a transferring process to teach, train, or research the knowledge, skills and habits from one generation to another generation.

Shape[26] – shape is mean as geometric properties of an object or its external boundary (outline, external surface). Shape can classify into two dimensions which is length and width as well as two types of shapes which is geometric shapes and organic shapes. Geometric shapes have clear edges such as circles, rectangles, square and more. While for the organic shapes are less well-defined edges and more natural.

Dyslexia disorder – Dyslexia disorder is meant that the defection of the brain's processing onto the graphic symbols and cause an impact to reading disabilities. People who are Dyslexia disorder have problems with reading comprehension. They not only suffer in word recognition, but also in spelling and decoding too.