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ANALYSIS OF PRODUCT DESIGN IN DEVELOPING LEARNING AIDS FOR DYSLEXIC CHILDREN

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ARTICLE INFO

ABSTRACT

This paper explores areas of product design in designing the learning aids for dyslexic children that rely on data definition. All of the data gathered were evaluated using suitable approaches, such as quantitative methods. The data were analysed using Statistical Package for Social Sciences or known as SPSS software. The bar graphs are shown using Microsoft Excel. In this study, the data were gained from a focus group comprising the educator and the parents of dyslexic student. All data were gathered to uncover a viable solution to the problem. This paper shows the analysed data to develop product learning aids from five designs that were developed from the collected data and existing product.

1.   Introduction

Areas of the study focus on products and people in these research areas. The study aimed to develop products for dyslexic children to assist them and manage their disabilities at the end of this research. Dyslexia has been classified as a learning disorder or disability. Furthermore, the paper mainly aimed at presenting the data obtained through questionnaires. The research area aimed to develop design knowledge for developing products or learning aids for dyslexic child users.

2. Literature Review

2.1 Product Design for learning aids

According to International Dyslexia Association, the learning disability is neurobiological in origin and is characterized by difficulties with accurate and or fluent word recognition and by poor spelling and decoding abilities. These difficulties typically result from a deficit in the phonological component of language that is often unexpected in relation to other cognitive abilities and the provision of effective classroom instruction. Secondary consequences may include problems in reading comprehension and reduced reading experience that can impede growth of vocabulary and background knowledge (Anny Sivilay, Oct 23, 2018). Dr Mullai Ramaiah, the president of the National Organization for Dyslexia Malaysia (NOD) noted that studies have shown that dyslexia leads to school dropouts, which opens the children to be at risk of being involved in social problems and even crime (Karen Arukesamy,19 Jun 2017). Based on a book authored by Stephen MacDonald, the author, juvenile delinquents are assessed in jail and it was found that impulsive crimes were committed by dyslexic children (Karen Arukesamy., 19 Jun 2017). Product design is a process that uses analytical thinking and a problem statement for any designer as a problem-solving approach which will improve the quality of life of the end user and their interaction with others to be improved. It is about visualizing, solving problems and creating a solution for the needs of the user. Design thinking comprises an approach to problem-solving that uses tools traditionally utilized by designers. The originality of design thinking is as an approach to solve problems that users face in daily life.

Teaching aids are a support to an instructor because they make it easier for the instructor to teach a concept to the students. The application of teaching aids involves any use of the senses of hearing and seeing. According to Murati and Ceka (2017), children are attracted to information and communication technologies as a way of life. Today's children tend to use interactive technologies at a very early age, so the school can adapt to their needs. Today, no occupation can function without the assistance of information technology. The advancement of technology today has an effect on the way education is accessed internationally and encourages faster and closer connectivity. In this case, collaboration may be evaluated as a medium to facilitate students in the research. Aside from that, it makes studying easier for students. Below are some examples of learning product designs for student.

Figure 1: Wooden learning product
(https://akokokids.com/en/learning-letters-and-numbers/22-alphabet-tracing-board-educative-toy-writing-learning-uppercase-letter-and-pattern.html)

Because of the recesses in the wood surface, the board helps the user trace the outline of the letters. When typing with a stick or finger, it guides the hand down the etched side. The toy aids the infant in his or her initial stages of learning to write. It teaches letter forms, trains the hand during proper writing, and stores memorized shapes. Furthermore, it improves motor abilities, accurate grip skills, eye-hand coordination, and concentration. The board provides many opportunities to learn through play. Letters may be tracked on the board, covered with grains, or moved to paper. Moreover, the toy offers hours of absorbing pleasure while still teaching. There are two sides of the board. The uppercase letters appear on one page. On the second hand, users can choose from tracing patterns or a custom-made child name. The child's name on the board provides extra inspiration to read. The kid will recognize that the toy is created specifically for her or him. Another feature is the size of the board is comparable to that of office paper, making it easy for a child to carry. Furthermore, it can be shipped without difficulty. Since the toy is made of solid wood, it is long-lasting, safe, and environmentally friendly. All of our toys are lovingly handcrafted in our studio, with particular attention paid to specifics and accuracy.

Figure 3: Learning Product Design

Education is typically synonymous with going to school or taking part in college program. This is what is called as systematic schooling. Formal schooling is usually institutionalized, mostly classroom-based, and strongly formal. There are lots of chances to read. Learning may happen as a byproduct of some other behaviour or as an incidental learning process. In general, this method of learning is called casual learning, but various terminologies are often used, or self-regulated learning is used. Informal learning is the product of an unplanned or unplanned case. Notice that the term non-formal learning (sometimes called semi-formal learning) is also used in the field of education. In relation to informal learning, non-formal learning is a planned yet rather adaptable practice set up by an institution or organisation. Informal learning takes place wherever people have the need, motivation, and opportunities to learn. Informal learning is defined as being combined with everyday activities, activated by an internal or external occurrence, not very conscious, and is an inductive method of thought and action (De Troyer et al. 2020).

Playful learning is often formulated in binaries, whether fun or hard, child or adult, and formal or non-formal learning. The word 'playful learning' does not have a coherent meaning. This is appropriate considering that it is a multidisciplinary area of science (Shelley et al. 2019). Playful learning means objects, artifacts, and technology that reflect a playful environment. In typical case such as learning by toys, dolls, demos, puzzles, virtual environments, and so on. Some techniques, such as learning methods, those promote role play, development, outcomes, challenges, and quests. On the other hand, tactile qualities such as mechanics and qualities that give rise to playfulness, such as surprise, humour, opportunity, competitiveness, storytelling, suspense, and badges. While children's involvement in school is vital to growth, growing evidence shows equivalent value of opportunities for children during 80 per cent of their wake-up hours spent outside school. Offering broad and flexible learning and skills-building opportunities in children's communities will supplement their in-school education with daily learning and skills growth. Analysis shows that playful learning can be more helpful to children than direct instruction in learning activities or the directive on learning practices (Schlesinger et al. 2020).

The idea of a play is inconceivable. There is a growing opinion, however, that it is an endeavour that is intrinsically inspired, that requires constructive participation, and that results in joyful exploration. Play is voluntary and even has no extrinsic purpose; it is enjoyable and mostly

random. Children are seen to be fully engaged and intensely totally immersed in play, building supervisory skills and contributing to educational achievement, because grumpy kids would not gain knowledge well (Yogman et al. 2018). Play often generates an expressive personal reality, including things that convince the public, which is not literal. Different cultures of adolescents in their world, children develop various experiences of playing. Play is not only about enjoying the moment; it's about taking chances, exploring, and testing limits. Pediatricians will be effective supporters by encouraging parents and primary caregivers to play with kids and giving children informal opportunities to play, as well as helping educators to consider playful learning as an important contributor to knowledge. The expectations of today's society need the instructional techniques of the past two decades, such as remembering, be supplemented by invention, implementation and transition (Golinkoff & Hirsh-Pasek, 2016).

Children's lives at primary school ages of seven to eleven years of age or at elementary school typically grow less self-centered, more mindful of the other system of ideals and convictions. Children communicate by preference at their age, less to personal advantage. The children have more pure friendship and mingle with a party. Their peers play a vital role, but the family is the most important. In the primary year, adolescents continue to discover the social meaning of digital activity. They can understand that real life is different from the fantasy world. Generally, the process of play focuses on cooperative and collaborative play (Roiha & Wiseman, 2021).

Product design must take sustainability into account. A sustainable product design involves environmental, social, and economic concerns that should be taken into account in the sustainable design. Development can be described here as fulfilling the requirements of the present without jeopardising future generations' ability to fulfil their own needs. It is critical to achieve sustainable development of the economy, society, and environment for a variety of reasons, including the decline of renewable sources, increased energy consumption in industrial production, tightened environmental legislation, increased consumer awareness of environmental issues, and many more. As a result, product designers are confronted with the problem of contributing towards the shift to sustainable development. Sustainable design considers environmental, social, and economic considerations during the design phase (Wahdan et al., 2019). The effect of product design extends across the whole product life cycle, from raw materials through processing and disposal. With a change in product design for additive manufacturing, the product supply chain must be reconfigured based on raw material requirements, new production methods, and end-of-life plans (Zhang et al., 2018). Due to the extreme increasing consumer desire for sustainability, sustainable product design has gained prominence in recent decades. To enhance the sustainability impact of goods early in the design process, a number of economic, social, and environmental aspects, which is manufacturing cost and time, product yield, capacity, consumer preferences, and pollution, must be taken into consideration.

Sustainability applies to preserving the inherent wellbeing, stability, and adaptability trend that keeps this world in a situation where life as a whole thrives at the bottom of this piece, all on regenerative cultures. The way contemporary cultures are organized does not need to be retained for this in the long run, but rather re-designed with a regenerative perspective, according to the author of Designing Regenerative Cultures (Wahl, 2016). Various renewable virgin materials, as well as byproducts and second-life waste materials have been turned into household goods, packaging, furniture, clothes and accessories, and construction materials. While recycled and biodegradable plastic items are frequently indistinguished from regular materials, new unusual materials have joined the market. The aesthetic qualities of materials are concerned with their sensory aspects, which include sight, touch, sound, smell, and taste. These sensory features arouse human senses, which are then processed as pictures to build users' perceptions of items or services.

Furthermore, the censorial experience is closely related to the aesthetics of materials, but the interpretative experience is about how people interact with the performance of materials. The emotional experience relates to how users feel, while the interpretative experience is characterized by how users perceive the meaning of content (Bahrudin et al., 2018).

3.   Method
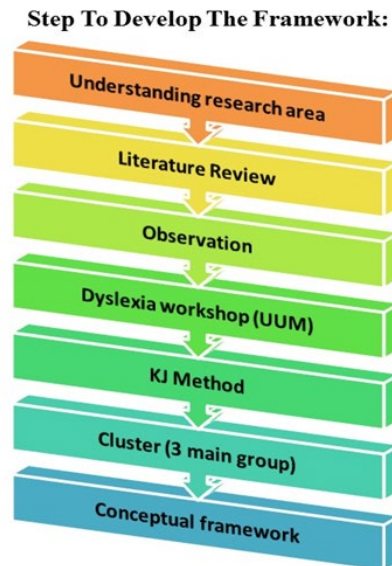
These steps are equally important of organizing keywords that have been collected through various ways. Firstly, the keyword is collected through literature review and other reading materials such as internet on a few portals, books, journals, articles, reports, previous studies, news, and so on. All the data from related research or books on Dyslexia children were recorded and analysed together to find out the main aims for this research. "Observation is a method in that it is defined as a method for analyzing and explaining a subject's actions. It is a means of gathering specific knowledge and observations through analysing, as the name implies", according to Hitesh Bhasin (March 5, 2020). In this step, observing or monitoring something or someone, the ability to notice things, especially significant details; the act of taking the altitude of the sun or another celestial body to find latitude or longitude; a statement based on something one has seen, heard, or noticed. All the data collected were recorded or written in to compile in one file.

Next is brainstorming, also known as creative thinking, group brainstorming, group ideation, and interactive brainstorming. Wilson, in his book in 2013, stated that "brainstorming is a means for individuals or groups to create ideas, improve innovative efficiency, or discover solutions to problems". Muddles of too many keywords will be sorted by the most show-up keywords and listed, which will then be brainstormed. The next step was gathering the keyword from Dyslexia workshop at University Utara Malaysia (UUM). In the early to mid stages of product creation, brainstorming is often used somehow whenever new concepts or solutions to the problem are desired, this approach is applicable. Materials such as sticky notes and pen are needed for this

method. The brainstorming session was conducted with degree students who major in industrial design at UiTM Kedah.Afterwards, during the brainstorming session, researchers applied the KJ method using paper cards that organise vague information into understandable knowledge, helping practitioners to be unbiased, uncover reality from observationally defined data. According to Viriyayudhakorn in 2013 the KJ-Process, developed with the Tadao UMESAO paper card scheme for intellectual efficient works, was first conceived by Jiro Kawakita in 1951 (Kawakita, 1991) to create a method for orienting cooperative works towards innovation. The KJ-Method title was taken from the original name of Kawakitas. These methods are used to organize a huge number of data in an orderly system for disorganization and numerous raw data. All the data and generating of ideas is gathered and put into group. If there is any similarity, it will be selected and brought up in a brainstorming session. After all the keywords are gathered, it creates three main cluster keywords which are learning disabilities, education, and child that develop the conceptual framework.

3.1   Conceptual Framework
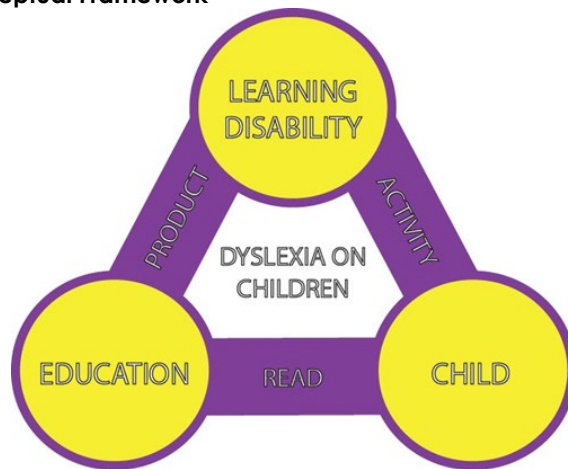
The above figure is developed from the brainstormed keywords in previous thinking studies. From all the collection of keywords and reading sources, these were extracted. The study narrowed down on education and learning aids products for dyslexic children in primary school age between 7 to 12 years old. First, learning aids for education is the main purpose of this research. The research targets to develop and enhance the learning aids for the target user. From brainstorming and organising keywords, education is the most selected keyword for the development of this product.

The conceptual frameworks in this study were created by brainstorming keywords from prior thinking research. These conceptual frameworks are based on a collection of keywords and reading sources to extract the necessary procedure in building learning aid designs. It will direct the research field in this study and add to specific knowledge in keeping this research on track. A currently available similar product may assist dyslexic youngsters in writing and reading. Furthermore, the conceptual framework will clarify the study's emphasis. The research focuses on education and learning assistance products for dyslexic children in elementary schools of age 7 to 12 years old. The goal here is to develop a product at the conclusion of this research using 3D software such as Rhino 4.0 and conceptual design on learning disabilities, notably dyslexia. The conceptual framework attributes assist this research in constructing a questionnaire for this study. In this sense, the conceptual framework comprises three major components. The major components are education, learning disabilities and childcare.

A conceptual framework is a structure that the researcher feels best explains the natural course of the phenomena being examined. It is related to the concepts, empirical research, and significant ideas employed in advancing and systematizing the researcher's knowledge. It is the researcher's discussion of how the research problem will be investigated. The conceptual framework provides an integrated approach to looking at an issue under investigation. In statistical terms, the conceptual framework describes the link between the primary concepts of a research. It is organised logically to help offer a picture or visual representation of how concepts in a research project connect to one another. Interestingly, it depicts the sequence of actions that the researcher wants to take out in a research investigation. The framework makes it easy for the researcher to specify and clarify the concepts inside the study topic (Adom, et.al., 2018). For some scholars, it refers to the particular or narrower thoughts that a researcher employs in such studies. It is a researcher's own developed model which the researcher uses to describe the relationship that exists between the important variables of this study. It may also be an application of a framework in an existing theory that the researcher adjusts to fit the research aim. It is the framework that demonstrates clearly how research inquiry has been conducted. It is made up of concepts that are interconnected to describe their links and how the researcher asserts to solve the research challenge established. Its goal is to promote the development of a theory that will be valuable to practitioners in the field (Adom, et.al., 2018).

In addition, here are the advantages of conceptual frameworks in a research. A conceptual framework indeed helps a research project in a variety of ways. For example, it aids the researcher in recognising and developing his or her viewpoint on the phenomena under investigation. It is the easiest approach for a researcher to give their proclaimed solutions to the problem that have been specified. It highlights the reasons whether a research issue is worth investigating, a researcher's assumptions, the academics with whom remain agrees and disagrees, and even how the conceptual supports researcher's methodology. The conceptual framework is usually applied by researchers when current theories are not suitable or acceptable in developing a strong structure for the investigation, as shown by this approach (Adom, et.al., 2018).

The data are frequently large, and part of the data may need to be compressed. Aside from that, certain thoughts may be missed since the subject may not communicate certain slight thoughts while applying the KJ approach. The list will be narrowed further to discover critical keywords for conceptual framework development. After the shortlisting, the keywords, names will be assigned to the groupings of keywords. Once the keywords had been selected, names were assigned to identify the groupings of the selected keywords. These groups were evaluated based on their importance in the study and appropriateness when applied in the conceptual framework. Only selected keywords were included as relevant keywords for this study based on observations of ideas in the literature review (Omar, W. N. F, et al., 2015). When the outcome is complete, the conceptual framework is divided into three major components, which are education, learning disability and child as a guideline in this research that was generated from literature review, observation, and workshop previously. Following the data clustering procedure, collection and planning were combined to uncover underlying patterns in the data. These patterns explored features of learning difficulty in children, notably Dyslexia. It explains how the education for dyslexic children theory translates into learning aids outcomes used in the classroom and at home.

4.   Results

4.1   Reliability Test Analysis

From the table of Reliability Statistics, it is shown that the alpha coefficient 73 items is .964, suggesting that the items have relatively high internal consistency. Usually, a reliability coefficient of .70 or higher is considered as acceptable in most social science research situations. Upon completing the reliability test in this study, it was found that the value of Cronbach's Alpha was .964 meaning that the reliability is excellent according to Gliem & Gliem (2003). The indicators of internal consistency are Cronbach"s alpha coefficient (Pallant, 2010), which is ideally above a 0.7 scale. The attribute used in the questionnaire required the respondents to tick their answer on an answer sheet. The respondents were required to rank their responses based on their understanding and knowledge regarding dyslexia, product design and relation to this. After conducting the test, the data collected were analysed using SPSS to test the reliability. Cronbach's alpha was conducted as a convenient test to estimate the reliability score. It was used to measure the scale of reliability in this study. The respondents were selected from a focus group. The number of respondents of 15 people were divided in two categories which were educator and parent. 86.7% of the respondents were educators and 13.3% were parents.

Table 1:
Case Processing Summary

	Case Processing Summar		**y**
		N	%
Cases	Valid	15	100.0
	Excluded[a]	0	.0
	Total	15	100.0

Table 2:
Reliability Statistics.

Reliability Statistics	
Cronbach's Alpha	N of Items
.964	73

Table 3:
List of Rubric of New Keyword

Product	Education	Learning Disability	Child	Activity	Read
Educators, Parents	training	apply	supporter	sense	trigger
Visual activity	figurative	representative	predictable	touch	calming
Sustainable	preserve	comfort	friendly	synthetic	material
Styles	form	familiar	trends	aesthetic	shape
Organic	natural	nonchemical	biological	squishy	art
Playing	texture	game	tone	tangible	
Learning aids	assist	technique	encouragement	tactile play	sensory
Planning & Organized	efficient	neat	orderly	smooth	motor
Helpful arrangement	systematic	logical	coherent	stimulation	pattern
Phrasing & Intonation	accentuation	speech pattern	voice	clear	aloud
Parents	practice	implementation	involvement	explore	discover
Playful	entertainment	multisensory	color	play dough	painting
Visual presentation	illustrative	visible	eye-catching	surface	brighter

The whole first step in the multicomponent process of developing a new product is conceptual design. Whether it's a structure, software, or a device, it's critical to start with a broad idea. The schematic design step immediately follows the conceptual design phase. Conceptual design entails a team persuading the project owner that perhaps the idea is worthwhile to pursue. Schematic design entails verifying that the notion as advertised is indeed possible. In reality, design crews are frequently guided by an initial project brief, and the idea stage entails collecting information and conducting data analysis. Many project plans nowadays integrate the conceptual and conceptual design stages, referring to this stage of project growth as conceptual (Stephanie Faris, 2018).

4.1   Demographic selection
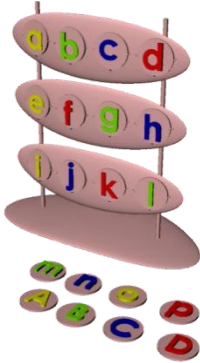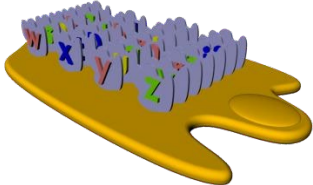
The respondents were selected from a focus group which included teachers and parents of dyslexic students in SK Bukit Kiara, Pusat Disleksia Sungai Petani, Inkubator Disleksia UUM Sintok and Kelas Disleksia SK Jalan Datuk Kumbar. 93.3% of the respondents were female. The majority of them by 40% were of age 31 to 40 years old. 46.7% by majority were in the government sector. Generally, education comprised degree level by 50% of the respondents. After all, 80% of the respondents were married and 100% of them were Malay. Remarkably, 60% of the respondents were educators and the rest were parents. 50% of the respondents rated agree, and another 50% rated very agree that education is important for learning disabilities, dyslexia children in

school. Among these two groups of respondents, as stated in the data, educators responded by 60% and 40% of the respondents were parents of dyslexic students.

4.2   Design Analysis

In conducting the research and analysing the data, targeted for dyslexic students, various design peripherals were used in order to gain useful insights from students' perspectives and usage. The data in pictorial and product design form are presented in the design analysis table below.

Table 4:
Validation Analysis Rubric

DESIGN	Education	Learning disability	Child	Read	Activity
	23.5% percentage	29.4% percentage	29.4% percentage	29.4% percentage	17.6% percentage
	41.2% percentage	11.8% percentage	11.8% percentage	11.8% percentage	23.5% percentage
	35.3% percentage	29.4% percentage	29.4% percentage	35.3% percentage	35.3% percentage
	41.2% percentage	41.2% percentage	41.2% percentage	41.2% percentage	52.9% percentage

	23.5%	23.5%	29.4%	29.4%	41.2%
	percentage	percentage	percentage	percentage	percentage
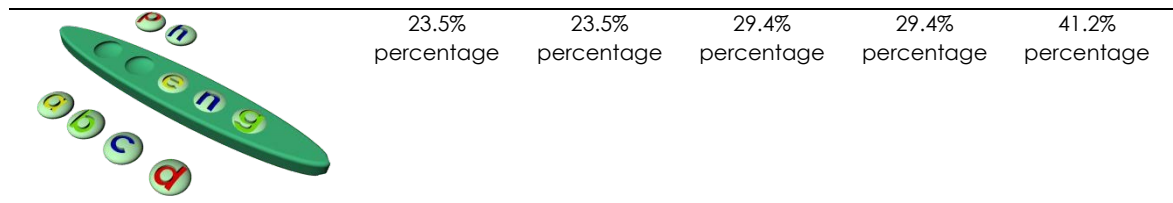
Google Forms is a web-based service that can be used by anyone to collect data. This software is commonly used to create surveys, quizzes, and other interactive tools. The form can be distributed among participants at any location by sending a link or an email. The information obtained from this form is often recorded on a spread sheet. In this study, the form was distributed to the intended respondents by the researcher. The data were gathered from 32 respondents in order to validate the design with five learning aids.

The respondents were requested to scale from strongly disagree to strongly agree. Table 4 shows the design of the learning products for dyslexic children that are driven by the core keywords, which are education, learning disability, kid, read, and activity. The keywords of education on design 1 are presented by 23.5% of the respondents which shares similar percentage to design 5 as the lowest scale. On top are Design 1 and 2 of the same highest percentage by the respondents with 41.2%. In between, education keywords from design 3 contain 35.3% percentage by the respondents.

Furthermore, learning disability keywords on Design 4 had the most outstanding scale, with 41.2% of the respondents; choice.. By 29.4%, design 1 and design 3 share second place in terms of respondents' choice. While design 5 obtained 23.5% followed by design 2 with 11.8% in the bottom.

Next keywords are child factors. At peak top with 41.2%, design 4 gained the majority of the respondents on the keyword child. While design 1, design 3 and design 5 share the same second place by 29.4%. Further below is design 2 with 11.8% of the respondents scale.

The data on the keywords read in Table 4 show 41.2% of which is the most outstanding scaled by the respondents. Second highest was 35.3% percentage which was design 3. Design 1 and design 5 were equally selected by the respondents with 29.4%. On the other side, design 2 obtained 11.8% and it is the ground position for keyword read.

Finally, the last keyword was the activity that needs to be applied to the design. First, design 4 was dominantly picked with 52.9% of the pick scale from the respondents. This was followed by Design 5 with 41.2% and design 3 with 35.3%. While, the second bottom was design 2 with 23.5% and the least selected was design 1 with 17.6%.
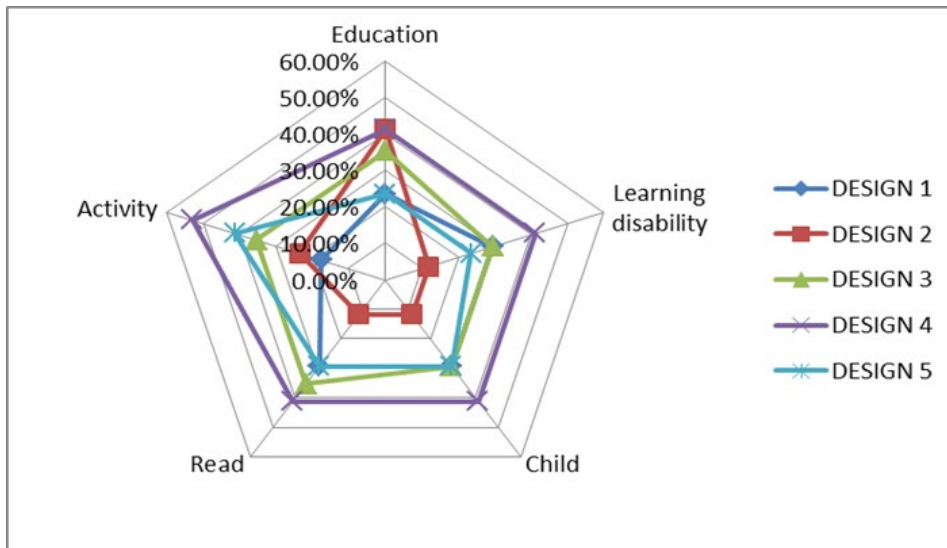
Figure 7: Validation Five Design with Spider web

Design 4 is a product driven by the core keywords; education, learning disability, kid, read, and activity, just like other designs, but it also includes other keywords such as planning and organized, next is playful and lastly is visual presentation. Moreover, Design 4 features four other colour variations on the alphabet, which are yellow, green, blue, and red. It also has uppercase or capital letters as well as smaller lowercase letters. The full alphabets are then placed on top of the foundation, causing the alphabet texture to rise to the top. These alphabet bases have the shape of an ellipsoid, with a floating alphabet in the centre. The alphabet base product masimply be taken in and then out of the main basis product.From this parametric observation based on the results, it is apparent that the majority of the respondents by 41.2% think design 4 matches the education criteria. Next, by 41.2% of respondent think that this product suitable for learning disablity criteria. Furthermore, there are 41.2% of respondents who chose the design match their target user child. The respondents'point of view was dominated by 41.2% who think that design 4 features the purpose for reading. Finally, 52.9% of respondents opined that design 4 accomplishes activity.

5.   Conclusion

In the light of these studies it complies with a product in assisting educators and caretakers of dyslexic person for them to cope with the impairment. This study will be valuable in the future for additional research into developing designs for learning aids. The emphasis of user product design is moving further away from utility and towards understanding and emotion-driven product features. Simultaneously, product designers may play a significant role in shaping future social contexts, as long as they are mindful of their responsibilities to users, society, and the environment. However, the underlying notion here for upcoming product design is that human values should always come first; that long-term effects should indeed be considered, and that every effort should be made to develop a sustainable future. The most essential thing to remember when designing products is that products are intended for human consumption. To create amazing products, the correct features must be combined with the appropriate user experience for the appropriate individuals. The core demographic is established, then the problems are investigated, and lastly

concentrating on creating a solution that answers those concerns. In conclusion, it aimed to improve existing learning aids to make it more effective and suitable for dyslexic children. Whatever was meant to be accomplished would be effective only if the user understood how to use the product in the right way

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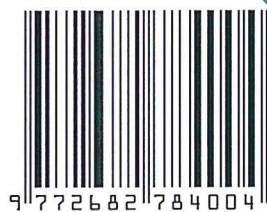Wilson, C. (2013). Brainstorming and beyond: a user-centered design method. Newnes.

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