# "Help me help you": Designing Visual Teaching Tools for The Autism Spectrum Disorder (ASD) Children

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## ABSTRACT

Children with ASD have difficulty with social imagining, which affects their communication ability, social skills, and behaviour. The purpose of this study is to evaluate the design characteristics of visual teaching tools used by instructors for ASD children, utilising the two elements of the VARK model: visual and kinesthetic. The effectiveness of learning sessions is dependent on the selection and deployment of teaching instruments that can provide ASD children with a better learning experience and stimulate engagement and communication during learning. Thus, a qualitative technique was used to investigate the ASD instructor's perspective on the visual teaching tools to support children with ASD using one-on-one and in-depth interview questions. The findings revealed that natural and pastel colours are the best choices for children with ASD, and materials that provide sensory help ASD respond appropriately. Future product designers can consider the colour selection, materials used, and type of teaching materials to attract children's attention while also contributing to their positive development, which allows them to think, solve problems, and be creative in a fun learning environment. Researchers should use the VARK model in the future to investigate how well children with ASD perform in auditory and reading skills.

# INTRODUCTION

Autism and Autism Spectrum Disorder (ASD) are both broad terms that represent a collection of complicated abnormalities of brain development in humans. According to the new Diagnostic and Statistical Manual of Mental Disorders 5 (DSM-5) issue, all autistic difficulties/disorders are integrated under one umbrella diagnosis of autism spectrum disorder (ASD). Autism is defined as a complicated developmental impairment that often affects children during their first three years of life and is caused by neurological problems that disrupt brain function. The prevalence of ASD is estimated to be one in every 110 births, with a higher frequency in children (Camacho‑Conde et al., 2022), which is four times higher in males (Nadeem et al., 2020). Furthermore, autistic children appear more exasperated in their social interaction and communication, as well as more stereotyped and rigid in their behaviour. This disorder is also linked to intellectual impairment (ID), and two of the most common neurodevelopmental disorders. Both disarrangements are exceedingly varied, and 40 percent of detailed cases have thus far been attributed to genetic mutations (Kasherman et al., 2020).

Autism, as reported by The National Autism Society of Malaysia (NASOM) in 2018, does not discriminate between racial, ethnic, or social preferences, and affects people regardless of family income, lifestyle, or education. Autism and associated behaviours are estimated to affect 1 in every 68 newborns. Children with autism also had difficulty with social imagining. The disorder affects three critical areas, namely communication ability, social skills, and behaviour. This study is critical in ensuring that children with autism are cared for particularly in their sensory special needs. In addition, if the ASD is not given sufficient consideration, autistic people can properly expect a lack of information, training, and understanding (Crompton et al., 2020).

# LITERATURE REVIEW

Autistic children struggle with social imagination, notably in communication, social skills, and behaviour (Crompton et al., 2020). Children with ASD had sensory issues, making it difficult for them to focus and pay attention to something. Many ways that educational tools are applied to children with ASD, such as playing serious games on mobile or tablet devices (Hannan Makki Zakari et al., 2014), a robotic approach by utilising LEGO Mindstorms EV3 (Norshuhani et al., 2018), robotic toys (Qidwai et al., 2013), and many more.

Innovation, particularly augmented reality, is increasingly being employed in mediations for children with special needs to cure or alleviate ASD symptomatology. The expanded reality is a form of innovation that creates a difference for everyone including children to easily interact with, which is not confined to one age group or level of knowledge (Wedyan et al., 2021). Furthermore, it has been shown that the utilisation of technology is a vital component of virtually every industrial industry. Over the last few decades, technology has begun to play a distinctive role in the distribution of instructional administration resources. Technology has equipped educational divisions with the essential gadgets and stages to nurture a range of curriculums (Mustafa, 2021). Furthermore, educators play a critical role in ensuring that children with special needs have access to online education (Tu et al., 2021).

Telehealth is an innovation in health care that uses broadcast communications, and it started in the medical, psychiatric, and mental health fields, where it is used most often. Later, people started using telehealth to help children with developmental disabilities with mediation exercises. Early uses of telehealth in this area include helping students, teachers, advisors, and parents (Simacek et al., 2021). In addition, Cakir and Korkmaz (2019) stated that augmented reality (AR) teaching materials can help children with special needs to learn better by giving them real-world experiences (Cakir et al., 2019).

Children seemed to change over time on blinded proximal measures of unrestrained vocalisation, social interaction, and impersonation as well as on blinded distal measures of verbal cognition, flexible behaviour, and extreme introversion side effects that were not affected by the intervention setting (Vivanti et al., 2019). Educators must also plan to help parents with problem-solving methods related to students' difficult behaviour or the need to respond to rules (Stenhoff et al., 2020). On behalf of parents, they must overcome the difficulty of understanding the requirements of children with ASD in the early stages so that it can be monitored.

The effectiveness of children with ASD's learning sessions depends on the selection and deployment of the teaching tools. With the right teaching tool, it can help in providing a better experience for children and encouraging more engagement and communication during the learning activities. Communication facilitation is critical in the context of autism. The disorder affects communication, resulting in a gap in the interaction between children with autism and their families and friends. However, only a few studies highlighted the importance of having a significant visual teaching product to assist children with ASD. According to Shabiralyani et al. (2015), the visual supports, such as images, drawings, objects, gestures, and print and environmental signals, might be beneficial. These visual supports are occasionally combined with verbal explanations, and it helps the children to understand what to do, gain new abilities, and feel included, as they take into account the needs of diverse learners (Shabiralyani et al., 2015).

Thus, in order to better understand the characteristics of appropriate visual teaching tools for children with ASD, the present study used the VARK model developed by Fleming and Mills (1992). VARK stands for Visual, Auditory, Reading, and Kinesthetic sensory modalities employed for information learning (Marcy, 2001). However, autistic children appear to favour visual and kinesthetic learning modalities (Colorosa & Makela, 2014). In fact, many autistic children struggle with the other two types, and they prefer to learn through visual and kinesthetic approaches (Vandermeer et al., 2015).

Educational products (teaching and learning materials) should be designed to engage children's visual senses and aid them in the learning process. Incorporating the appropriate aspects of art and design principles into the design of the visual teaching tools can help in giving a better experience for students and motivate more involvement throughout the learning activity. As a result, this study investigates the design characteristics of visual teaching tools used by educators to educate children with ASD using two elements of the VARK model, namely visual and kinesthetic.

## METHODOLOGY

This study used the qualitative research method to explore the visual teaching tools applied to support children with ASD based on the perspective of the ASD instructors. The one-on-one and in-depth interview sessions were conducted to answer the research questions. The researchers' list of questions was utilised as a guideline, and the questions were treated in a similar manner to meet with participants' conditions, feelings, and areas of concern (Creswell, 2014). Purposive sampling (also known as assessment, specific, or subjective testing) was used in this study.

The objective of this research is to look into the design characteristics of visual teaching tools used by instructors to educate children with ASD. While the research question is closely tied to the study, inquiring, *"What are the design characteristics of visual teaching tools used by instructors to educate children with ASD?"*

## Procedure

In the initial phase, the research questions were developed thematically to align with the aim of the study. Purposive sampling was employed, and specific samples of instructors specifically in handling the children with ASD were chosen. The qualitative data were collected via face-to-face discussions in multiple locations, depending on the agreement of both interviewer and the interviewee. A question list was used as a guideline, and the questions were addressed in accordance with the conditions, emotions, and locations of the informants. All data received were transcribed, and member checking was completed. Finally, the qualitative data from the interviews were analysed using the MAXQDA software application.

## Population and Sampling

In this study, four experts from the National Autism Society of Malaysia (NASOM) were selected as the informants. Their experience in assisting children with ASD is relevant to the current study and was critical in strengthening the findings (Newman, 2014). The informants were selected due to their vast experience in handling and teaching ASD children. Evidently, having the experts in the study would resolve the understanding of the subject, thus contributing to the wider knowledge and benefits of the present study. According to Romney et al. (1986), four to five experts are enough participants to be included in one study if the participants have a high level of knowledge and expertise concerning the topic of inquiry. Meanwhile, according to Baker and Edwards (2012), a minimum of one participant or more is sufficient if the participant completes the study's research scope or type of inquiry. Saunders and Townsend (2018) supported this statement and guaranteed that one participant is enough to establish the relevant findings. All informants have extensive experience ranging from 5 to 7 years in their field. Table 1 shows the informant descriptions, which are coded systematically to keep personal information hidden. The participants were coded as INS (1-4), which is defined as "instructor," and the number from 1 to 4 indicates the code of participants (see Table 1).

**Table 1 Descriptions of the ASD's instructors and coding**

| Informant | Date of Interview | Job Descriptions / Workplace | Year(s) of Experience | Coding |
|---|---|---|---|---|
| Instructor 1 | 18 October 2021 | Teacher/ The National of Autism Society of Malaysia, NASOM, Setia Alam | 7 | INS(1) |
| Instructor 2 | 18 October 2021 | Teacher/ The National of Autism Society of Malaysia, NASOM, Setia Alam | 5 | INS(2) |
| Instructor 3 | 18 October 2021 | Teacher/ The National of Autism Society of Malaysia, NASOM, Setia Alam | 5 | INS(3) |
| Instructor 4 | 1 November 2021 | Teacher/ Homeschooling | 6 | INS(4) |

## Interview Instrument

Thematic analysis was used, where the interview questions were constructed in two main themes based on the VARK model, which are i) Visual, and, ii) Kinesthetic. Seven questions were designed and categorised according to each theme, as shown in Table 2. Each question created is considered to collect and analyse information from the informants.

**Table 2 Interview questions for the ASD's instructor**

| Themes | Categories | Questions |
|---|---|---|
| Visual | Colour | • Do autistic children know colours? <br> • What effect does colour have on autism? <br> • Are bright colours good for autism? <br> • What colours are soothing for children? |
| Kinesthetic | Texture | • What are some sensory issues with autism? |
| | Teaching material | • What type of teaching materials you used in class? |
| | Attentiveness | • How long can autistic children focus in a single learning session? |

## RESULTS AND FINDINGS

This section reflects on the results of the interviews with the focus group. It presents the analysis of their verbal responses during the interviews. Four informants were interviewed using one-on-one and in-depth interview questions and delivered differently to the targeted informant. The responses were categorised into two themes, which are (i) Visual and (ii) Kinesthetic. The transcription details are provided in the following section.

### Descriptive Analysis on the Interview of the Visual

Table 3 shows the coded answers of the informants to four different questions on the design characteristics, which are categorised into (i) autism and colour, (ii) colour effect, (iii) bright colour, and (iv) soothing colour. The responses of each informant are disclosed and coded in the following table (Table 3).

**Table 3 The interview coding and theme (visual)**

| INFORMANT | VISUAL | | | |
|---|---|---|---|---|
| | **Autism & Colour** | **Colour Effect** | **Bright Colour** | **Soothing Colour** |
| **INS(1)** | Only some colour | Prefer natural colour | Bright colour not suitable | Blue, green, grey |
| **INS(2)** | Having difficulties to understand | Natural, Blue gives calmness to them | Bright colour not suitable | Blue, green, natural colour |
| **INS(3)** | Having difficulties to understand | Pastel and natural | Bright colour not suitable. prefer pastel and natural | Blue, pink, grey, pastel |
| **INS(4)** | Only some colour | Prefer natural colour | Bright colour not suitable | Any natural colour – blue and pastel |

### ASD children's interaction with colour

Based on interviews with four informants in the Klang Valley, informant INS(2–3) reported that children with ASD have trouble perceiving colour. *"Some autistic children may not comprehend and do not even react to the colour presented to them"*, INS(2). Informant INS(3) also stated a similar answer: *"It is difficult for children to recognise the colour"*. In contrast, informants INS(1) and INS(4) stated that ASD children can only recognise a subset of colours. Informant INS(1) claimed the ASD children can only detect colours if the colours are distinct from one another.

*"Due to their similarity, the colours yellow and orange are confusing to ASD children."* INS(1)

*"ASD children can understand if colours are not presented in the same tones."* INS(4)

Meanwhile, all of the informants agreed that natural colour is the ideal colour to draw the attention of ASD children. The INS(2) added the use of blue as the teaching tool colour that can calm the children. *"I've discovered that blue soothes ASD children."* According to the INS(4) informant, pastel colours such as pink and pale blue have relaxing and positive effects on autistic users. *"In addition to natural colours, pastel colours such as pink and pale blue bring calmness and positive effects."*

The informants were asked about the advantages of using bright colours in teaching tools for autistic children. All of the informants agreed that bright colours were inappropriate for ASD children. Furthermore, the informant INS(3) stated that, *"if for the teaching tools, the children are more attracted to pastel and natural colours."* To have a better understanding of the visual look of the preferred soothing colour for ASD children' teaching tools, the informants included these answers:

*"The blue, green and grey are soothing colour for the ASD children."* INS(1)

*"The blue, green and, natural colour"* INS(2)

*"Blue, pink, grey, pastel"* INS(3)

*"Any natural colour like blue and pastel"* INS(4)

### ASD children' kinesthetic

Table 4 presents the coded responses of informants to three major questions related to kinesthetic, which are classified into three categories: (i) texture, (ii) teaching material, and (iii) ASD children's attentiveness. The responses of each informant are displayed and coded in the following table.

**Table 4 The interview coding and theme (kinesthetic)**

| INFORMANT | KINESTHETIC | | |
|---|---|---|---|
| | **Texture** | **Teaching material** | **Attentiveness** |
| **INS(1)** | Certain textures might be overwhelming, causing sensory avoidance | Teaching tools for ASD with texture surfaces, timers, board and cards | Interesting activity are needed to ensure ASD concentrate learning session |
| **INS(2)** | Introduce new texture | Visual Aids with important aspect structure of teaching ASD | Focus activity that can interest ASD more than 10 minutes |

| INS(3) | Learning instruments based on texture and surface | Teaching tools that related with Building Communication, Life Skills and Social Skills | Activity that relates with communication and big picture of what they are learning |
|---|---|---|---|
| INS(4) | Materials that providing sensory help ASD respond appropriately | Assemble a sensory toolbox for ASD | Apply various teaching tools with different object to grab attention more than 15 minutes in one time |

According to informants INS(1 and 2) in Table 4, ASD children require tactile products to receive better learning sessions. *"Certain textured surfaces can be overwhelming. ASD children may experience sensory avoidance as a result of this"*. Meanwhile, informant INS(2) responded similarly: *"Texture is the biggest issue for ASD children." From an educational standpoint, we introduce them to a new texture in a fun way"*. According to informants INS(1) and INS(2), ASD children can only recognise learning instruments based on texture and surface. Informants INS (3-4) encourages them to select appropriate materials as learning tools. The details interview transcripts are shown as below:

*"ASD Children regularly dismiss toys as learning instruments based on their texture and surface. Depending on the underlying cause, there are different approaches to encouraging them to choose the right materials as learning tools."* INS(3)

*"It is difficult to respond appropriately due to sensory issues. For example, lights can be too bright, sounds can be too loud, textures can be scratchy, and food can be too spicy. Failure to provide sensory data at that point can result in frustration and behavioural issues."* INS(4)

Meanwhile, all of the informants agreed that ASD children are either overly sensitive to surface and require texture, or both. In addition to discussing the importance of texture, the informants were asked, *"Do autistic children enjoy sharing toys in class?"* According to informant INS(2), ASD children are also drawn to texture, which can impact their personal senses. His answer is, *"Yes, because children with autism frequently enjoy personal sensory toys because they help them feel calm and lock in their senses in a positive way."* Meanwhile, other informants stated that teaching tools and toys for ASD children should engage them with product-based ones that allow thinkability, problem-solving, and creativity.

*"Sometimes, because with support, autistic children can progress from playing alone to playing cooperatively with others."* INS(1)

*"Depending on what toys they like, playing with toys can help ASD children develop thinking, problem-solving, and creative skills as they figure out what to do with their toys when they play alone."* INS(3)

*"Sometimes, children with ASD have no interest in their peers."* INS(4)

Based on the correlation between these paradigms, Table 4 discusses the relationship between kinesthetics and educational materials for children with ASD. On the basis of the instructional tools utilised by children with ASD, the informants were queried about the type of instructional product that should be utilised. According to all informants, textured surfaces, timers, boards, and cards should be included in the design of educational materials for children with ASD (INS1-4). In addition, the visual aids must include an essential element and structure associated with the development of communication, life, and social skills. The following is the informant's transcript (INS1-4) of the visual teaching materials for ASD children:

*"Toys typically used in the classroom can be utilised to teach children with ASD. Examples include textured surfaces, timers and clocks, and board games."* INS(1)

*"Utilise Visual Aids because visuals are an integral part of teaching autistic children. Line drawings, photographs, and Dialect Builder Picture Cards, for instance, can be incorporated into various daily activities, whereas picture plans and mini-schedules provide structure."* INS(2)

*"Teaching tools for developing communication, life skills, and social skills." These include magna-tiles, multiplication machines, wobble chairs, magnetic blocks, gel sensory shapes, calming cuddle balls, and mix-and-match sensory shapes."* INS(3)

*"Our team (teachers) assembles a sensory toolbox of home and school-useable activities and equipment. Therefore, students can bring their toolboxes to their homes and receive care from their caregivers."* INS(4)

The final question in regards to the ASD children's attentiveness was asked to the informants to have a better grasp on the kinesthetic theme (refer to Table 4). The informants were asked, *"How long can ASD children focus in a single learning session?"* According to INS informants (2 and 4), children with ASD can only focus on learning activity for less than 15 minutes.

*"Below than 10 minutes in one session. After that, they struggle to focus in one activity."* INS(2)

*"Not more than 15 minutes in one time. Because the ASD children don't always pay attention to the people and same object around them."* INS(3)

In contrast, informants INS(1) and INS(3) stated that ASD children are only responsive to activities that trigger their interest, such as the activities that involve communication and the big picture of what they are learning.

*"Depends on their interests and activities, since ASD children struggle to concentrate on things that do not interest them."* INS(1)

*"ASD children struggle with socialisation and communication." It can be difficult for them to focus in an overstimulated environment and to get a handle on the big picture of what they are learning."* INS(3)

All data received were meticulously recorded and presented in the subsequent section. The discussion was centred on the two themes highlighted by the VARK model: visual and kinesthetic.

## DISCUSSIONS

This study utilised the visual and kinesthetic components of the VARK model created by Fleming and Mills (1992). Based on the findings of this study, two sophisticated discussions are held: (i) colour affects the learning engagement of ASD children; and (ii) texture's relevance to ASD children.

### Colour Affects the Learning Engagement of ASD Children

Colour has a strong influence on ASD children, especially in the classroom. ASD children's reactions to colour differ from the average normal children. Choosing the right colour for an educational space for children with ASD is critical in order to create a positive environment for these children. The plan of the environment can moreover adversely impact the stress level of children, particularly ASD children. The consideration of how colour overlays affect reading speed among children with ASD. The use of psychologically appropriate colours provides them with a fun learning experience as well as outer peace. Furthermore, different vibrations of colour on things can give distinctive impressions to a child. A room painted in warm and happy colours, for example, creates an easier and convenient place for teaching

and learning than a class painted in a dark colour that conveys boredom and self-absorption. The best use of colours in education is critical to pique the interest of children with ASD.

Natural and pastel colours were found to be the best choices for children with ASD. According to Gareth (2021), lighter shades and pastel colours, like beige, greys, creams, or tans, have a calming effect. However, the white colour was the least friendly to ASD children, due to the significant effect of being too bright and tiring for the eyes. Furthermore, the white tones represent the uneasy feeling associated with clinics, hospitals, and medical (Gareth, 2021). This finding was intriguing, and it can help product designers take it into account when creating visual teaching tools for ASD children. Despite being placed in the natural colour category, the use of white as a dominant colour for teaching tools should be considered.

Colours in the bright category, such as red, orange, and yellow, on the other hand, were advised to be used only on toys and play objects. Changes in intensity or colour brightness may contribute to negative effects such as tantrums in ASD children (Team, 2021). It is recommended that visual teaching tool designers assess and calculate the risks before deciding how much bright colour to include in the visual appearance of the teaching tool.

### Texture's Relevance to ASD Children

Kinesthetic intelligence, which was initially associated with material abilities, was defined and discussed in Howard Gardner's Frames of Mind: The Theory of Multiple Intelligences in 1983. Furthermore, kinesthetic learners are similar to tactile learners in that they prefer hands-on experiential learning. Three major kinesthetic element discoveries concerning texture relevance to ASD children were made. The importance of selecting the appropriate texture and materials, as well as suggesting materials that provide sensory assistance to ASD children, is first highlighted. Textures are carefully planned to provide maximum sensory stimulation, especially for ASD children. Meanwhile, the discovery was intriguing, and it can help product designers to think more creatively when developing visual teaching tools for ASD children (Siti Zunaida et al., 2020).

Furthermore, visual aids are a medium that can improve the attentiveness of ASD children. Products with tactile symbols or objects of reference, for example, are available on the market and can aid in the development of ASD children. Packaging and food labels are two examples. In addition, products are formed in photographs, miniatures of real objects, coloured pictures, plain squares of coloured cards, symbols, and so on. In fact, it is a designer's need to create visual teaching tools that are specific to ASD children due to their sensory needs.

As a result, positive development and attention of children with ASD can only be achieved if visual teaching tools are designed with their abilities and capabilities in mind. According to Cardon (2007), visual support is important because of the features of visual teaching tools that can meet the needs of children with social challenges, language abilities, and social skills. Finally, the role of the product designer is crucial in the creation of visual teaching tools that can alleviate the social development challenges of children with ASD (Cardon, 2007).

## CONCLUSION

In conclusion, this study has successfully connected the dots to understand the true phenomenon of the design characteristics of visual teaching tools. The VARK model was used in this study to guide the search for visual and kinesthetic elements in effectively producing visual teaching aids for ASD children. Significantly, this study was beneficial to product designers in understanding the important elements and characteristics in designing the visual teaching aid for targeted users. Future product designers should consider colour selection, texture or materials used, and type of teaching materials in order to attain children's attention, while also leading to their positive development, which allows them to think, solve

problems, and be creative in a fun learning environment. Although this study only investigates the visual and kinesthetic components of the VARK model, future researchers could explore the auditory and read/write abilities of ASD children.

## ACKNOWLEDGMENT

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