



## EARLY SCREENING TOOL FOR AUTISM SPECTRUM DISORDER FOR VISUAL IMPAIRMENTS

Che Ku Nuraini C. K. M<sup>1</sup>, Shahbodin F.<sup>2</sup>, Zareena R.<sup>2</sup> and Suriawati S.<sup>2</sup>

<sup>1</sup>Centre for Research and Innovation Management, Universiti Teknikal Malaysia, Melaka, Malaysia

<sup>2</sup>Faculty of Information and Communication Technology, Universiti Teknikal Malaysia, Melaka, Malaysia

E-Mail: [cknuraini@utem.edu.my](mailto:cknuraini@utem.edu.my)

### ABSTRACT

The aim of the present study was to evaluate developed screening tools on autism students' to detect early signs especially on visual for ASD children. Early intervention in autism spectrum disorder (ASD) improves outcomes, but treatment access depends on early identification. Method of collecting data was using tool, observation and interview. Design stage produces flowchart and storyboard and development stage produces learning media with conceptual characteristics presented through materials equipped with visualization in the form of videos, pictures, sound and text. The results of this research illustrate that there is a positive score and feedback from children with autism. Besides that, children with autism are easy to focus using this tool. Recommendation of a screening for autism disorders in practice when concerns from parents or family are not raised, challenge the quality of the instrument and the overall screening procedure. The benefits of early ASD screening and detection must be weighed against the risk for false positive test results causing parents unnecessary worry.

**Keywords:** autism tool, serious games, visual perception, screening, technology.

### INTRODUCTION

Autism Spectrum Disorder (ASD) or autism is a developmental disorder that affects a person's social communication and interaction. Individuals with ASD also have restricted and repetitive behavior, interests and activities. These characteristics fall across a "spectrum" ranging from mild to severe. While one person may have symptoms that impair his or her ability to perform daily activities, another may have only mildly noticeable differences and have few, if any functional impairments. Autism spectrum disorders (ASD) affect 1 in every 59 children in the United States (Baio *et al.*, 2018). Early treatment can greatly enhance patients functional independence and improve outcomes (Dawson & Burner, 2011; Rogers & Vismara, 2008; Warren *et al.*, 2011). Although early ASD presentations are heterogeneous, early signs such as differences in language and cognitive abilities, reduced levels of social attention and communication and increased repetitive behaviors with objects have emerged in the research literature as common indicators of ASD within the first two years of life (Zwaigenbaum *et al.*, 2015). Ideally, pediatricians and other early childhood professionals who routinely see very young children are well trained in screening and detection of signs and symptoms of autism and are familiar with developmental, educational, and community resources as well as medical subspecialty clinics (Filipek *et al.*, 2000; Johnson *et al.*, 2007; Nadel & Poss, 2007). There is, however, no existing research regarding how early childhood professionals weigh evidence from parent concerns, observations, and screening when making referral decisions. Because they are in prime position to observe symptoms and make decisions about initial referrals, we believe that referral decision-making processes of early childhood professionals are an important area for research. Although parent and provider early identification actions are complicated by the

heterogeneity of autism symptom presentation, the importance of decision factors and processes of early childhood clinicians and educators regarding referrals deserves greater scrutiny. A comprehensive search of the literature identified a significant gap in our understanding of what factors early childhood professionals consider when making decisions about whether to refer a child for a comprehensive autism evaluation. In order to better understand current practice in decision making about autism referrals, early childhood professionals were asked across disciplines to make judgments about autism risk based on observations, then asked which factors they considered when deciding whether or not a child exhibited early signs of autism and needed a referral for additional assessment. Videos were of children with and without autism undergoing evaluations with targeted opportunities for observation of social communication and restricted, repetitive behaviors.

Despite reliability of most autism diagnosed by age 24 months, the majority of children with autism do not receive comprehensive evaluations until after age 36 months. Although many possible reasons exist for delayed evaluations, the process itself is not clearly defined nor understood. In particular, little is known about how perceptions of early childhood symptoms of ASD interact with decision criteria to ultimately refer a child for comprehensive diagnostic assessment. The autistic child is typically diagnosed before 3 years of age (Faras *et al.*, 2010). In the manual of psychiatric diagnosis, autism was not considered a distinct disorder, nor was it considered by most to be biologically based until the 1980s. This review provides a comprehensive literature survey on ASD, with a particular focus on data obtained by investigators in the Gulf region. This might ultimately help to improve the assessment and treatment of ASD on the Arabian countries.



## AIMS

The aim of the present study was to evaluate developed screening tools on autism students' as early detection detect early signs especially on visual in order to of ASD in children. Screen positive children were supposed to be referred for diagnostic evaluation with clinicians.

## HOW IS ASD FIRST IDENTIFIED?

Pediatricians are often the first contact when parents become concerned about their child's development. During office visits, the physician may ask questions about the child's development, and parents often share their concerns at that time. The American Academy of Pediatrics (AAP) recommends that pediatricians screen for ASD during well checks at 18 and 24 months and at any

time a parent raises a concern. Pediatricians will ask the parent questions to assess their child's progress toward typical milestones. They may utilize one of the commonly used screening instruments, such as the Modified Checklist for Autism in Toddlers (M-CHAT) or the Childhood Autism Rating Scale (CARS). Careful consideration of parents' responses on the screening instrument allows the pediatrician to determine if there is cause for concern and referral. If the screening indicates a number of red flags, the pediatrician may recommend that the child participate in a multidisciplinary evaluation. Although the initial screening does not result in a diagnosis, it provides valuable information for the parents so they can begin treatment while waiting for an appointment with a full evaluation team as shown in Table-1.

**Table-1.** Developmental Milestones.

By 12 months, most children will:	<ul style="list-style-type: none"> <li>▪ Imitate simple actions like clapping</li> <li>▪ Use basic gestures like waving and pointing</li> <li>▪ Respond when their name is called or when they're told "no"</li> </ul>
By 24 months, most children will:	<ul style="list-style-type: none"> <li>▪ Enjoy playing with other children</li> <li>▪ Identify many different objects</li> <li>▪ Use 2-4 word phrases such as "want juice"</li> </ul>
By 36 months, most children will:	<ul style="list-style-type: none"> <li>▪ Play imaginatively with a variety of toys</li> <li>▪ Follow complex instructions</li> <li>▪ Speak in 4-5 words sentences</li> </ul>

Source: The Centers for Disease Control and Prevention (CDC) (2014)

## SCREENING

Screening refers to the recognition of certain developmental and behavioral signs and symptoms that may be cause for concern to the caregiver or physician while the diagnostic assessment establishes if those concerns can be attributed to either ASD or a different cause (NICE, 2011). Screening for ASD is important as early detection enables early intervention and better outcome. There are limited studies on the effectiveness of screening tools for ASD in children. Three reviews looked into the screening of young children for ASD and found that Checklist for Autism in Toddlers (CHAT), Modified Checklist for Autism in Toddlers (MCHAT) and Social Communication Questionnaire (SCQ) performed better in the screening. The primary studies were inadequate with small sample sizes, lack blinding between screening and diagnosis, and largely did not follow up children with negative results. It is important to be aware that false positive or false negative results from any use of screening

tests may delay correct diagnosis and cause unnecessary parental anxiety. The ultimate decision about the need for referral and further assessment should be made on clinical grounds.

Besides that, screening is also can be defined as a brief, formal, standardized evaluation used to identify unsuspected deviations from normal patterns of development. A screening instrument enables detection of conditions or concerns that may not be readily apparent without screening. Screening does not provide a diagnosis but it helps to determine whether additional investigation example a diagnostic evaluation by clinicians with special expertise in pediatric development is necessary (Dawson et al, 2010). Effective screening requires that results from standardized screening tests be considered in conjunction with clinical judgment. Desirable characteristics of developmental and behavioral screening tests are discussed separately.



The issue of screening young children for autism spectrum disorders (ASDs) received increased attention following publication of a report by the American Academy of Pediatrics (AAP) in 2007 (Dough, 2011). However, before adopting screening tests into clinical practice, certain standard criteria should be met. Screening signifies looking for disease in persons without symptoms and should not be confused with diagnosis, which involves testing to confirm disease when it is suspected. A screening test should be easy, accurate, safe, and acceptable. It should detect most cases of disease with minimal false-positive results. A treatment of proven effectiveness should be available, with convincing evidence that early detection in the asymptomatic patient leads to improved, clinically important outcomes compared with later detection, when the condition manifests and the patient is symptomatic. The benefits from detecting the condition in a few patients should also outweigh the harms that can accrue to other patients from false-positive results, unnecessary workups, adverse effects of treatments, and lost opportunities for more meaningful interventions. ASD can sometimes be detected at 18 months or younger. By age 2, a diagnosis by an experienced professional can be considered very reliable. However, many children do not receive a final diagnosis until much older (Lord *et al.*, 2006). Developmental screening is a short test to tell if children are learning basic skills when they should, or if they might have delays. During developmental screening the doctor might ask the parent some questions or talk and play with the child during an exam to see how she learns, speaks, behaves and moves. A delay in any of these areas could be a sign of a problem.

Screening tools are designed to help identify children who might have developmental delays. Screening tools do not provide conclusive evidence of developmental delays and do not result in diagnoses. A positive screening result should be followed up with your child's health care provider immediately if you think something is wrong.

#### a. Modified Checklist for Autism in Toddlers

Modified Checklist for Autism in Toddlers (MCHAT) is a 23-item questionnaire on child behaviour reported by parents for children aged between 18 and 24 months of age. It has been translated into Malay and Chinese languages for local use in healthcare facilities in Malaysia. Training is required for interpretation of the result. The specificity of MCHAT was reported as 98% and follow-up of a subset of children at age 3.5 years resulted in a sensitivity of 100%. In a recent review, the sensitivity, specificity and were found to be 70% to 92%, 27% to 43% and 5.8% to 76% respectively. MCHAT was also better at detecting autism in children aged 24 months versus (vs) 18 months and those in high risk group in early intervention programme centres vs low risk group in the routine babyclinic.

#### b. Social Communication Questionnaire (SCQ)

Social Communication Questionnaire (SCQ) is also a parent-rated questionnaire on children above four

years old. It evaluates the social interaction, communication, language and stereotype behaviors of for possible autism or other ASD. SCQ was better in detecting ASD in individuals over seven years of age (sensitivity of 86% to 90% and specificity of 78% to 86%) compared to children aged 2 - 3 years old (sensitivity 47% to 54% and specificity 89% to 92%).

#### c. Other Screening Tools

Other screening tools used are:

- Modified Checklist for Autism in Toddlers, Revised with Follow-up<sup>17</sup>
- Checklist for Autism in Toddlers (CHAT)<sup>12</sup>
- Gilliam Autism Rating Scale / Gilliam Autism Rating Scale Second Edition (GARS /GARS-2)
- Social Responsiveness Scale (SRS)
- Autism Spectrum Screening Questionnaire (ASSQ)
- Asperger Syndrome Diagnostic Scale (ASDS)
- Checklist for Autism in Toddlers for Chinese Children (CHAT-23)
- Child Behaviour Checklist (CBCL)

#### TREATMENT

Early diagnosis and prompt intervention of children with ASD is crucial for the best outcome. The important of recognizing and initiating early referral to optimize the child's potential must be emphasized. Children with autism spectrum disorder should be managed by a multidisciplinary team consisting:

- family medicine specialist
- pediatrician
- psychiatrist/child and adolescent psychiatrist
- clinical/educational psychologist/counsellor
- occupational therapist
- speech-language therapist
- social welfare officer
- educational officers
- teachers

#### RESULTS

In this study, a screening tool was developed to test a visual perception screening tool called ViPer Games. This five-phase systematic model, namely Analysis,



Design, Development, Implementation and Evaluation or ADDIE is used to guide through the process of creating multimedia products for a variety of settings.

Vi-Per Games stands for Visual Perception Games. Each phase of the ADDIE model is an important element of the design process. In each phase, decisions, iteration and testing are made to ensure the effectiveness of the game. Figure-1 shows a Diagnostic Report Scoring. Once students have completed all games, observation of visual diagnostic results will be displayed.

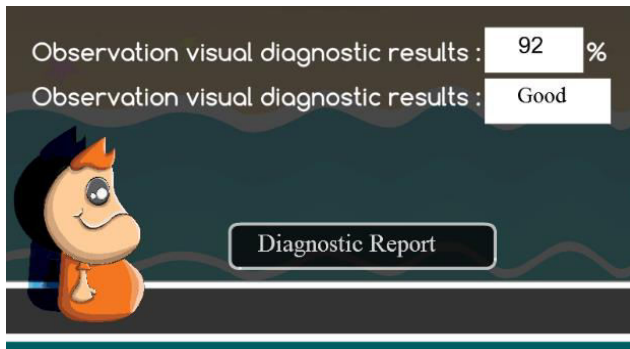


Figure-1. Diagnostic Report Scoring.

Figure-2 shows Vi-Per Games Student Information Interface. It displays Visual Observation Diagnostic Test Report and Games Report. The report of the games will summarize the skills, games name, types of observational, marks and level that are scored by students.



Figure-2. Vi-Per Games Student Information Interface.

## DISCUSSIONS

It has been reported that existing screening tools depending on parents' observation abilities often have unsatisfactory value in discriminating between ASD and non-ASD within the group of children showing atypical development (Oosterling et al., 2009). Although some appropriate screening tools for early detection of ASD have been developed, there is still a need for brief, easy to handle assessment instruments designed for use in the primary health care system. According to Robins (2008), their research team developed the OSA (Observation Scale for Autism) designed to be a time-efficient observation scale, easy to administer, and suitable for children under 3 years. The instrument was designed to perform independently of social, language, and cultural

background. The mentioned requirement was especially important when the diagnostic tool should be used in the multicultural city of Malmo. The instrument was developed to be a part of the existing 30-month follow-up program in the Swedish Child Health Care (CHC) services, offered free to all children. To the best of our knowledge, we are not aware of any true level-1 screening study in which all children were tested with an observation instrument. The results from a pilot study evaluating the OSA (Haglund et al., 2015), suggested the instrument to be able to discriminate children with ASD from children with typical development, and from children with Down syndrome. The group was included to evaluate the performance of the OSA in a group of children with developmental delay. According to the pilot study, using a suggested cut-off (scoring negative in 3 items or more), the OSA provides high sensitivity for ASD (92%) with low false-positive rates.

## CONCLUSIONS

Specialists at leading autism care centers are working with patients and their families to improve the health and quality of life of all those with autism by developing and disseminating evaluation and treatment guidelines for healthcare providers (Perrin et al., 2016). This effort also includes autism-specific medical education and teleconferencing programs to share expertise (Mazurek 2017). Early screening and diagnosis can make a huge difference in the lives of children with autism spectrum disorder (ASD) and their families. It is not always easy to make an ASD diagnosis. There is no lab test for it, so doctors rely on observing the behaviors of very young children and listening to the concerns of their parents. ASD has a very wide range of symptoms. Some people who are on the spectrum have severe mental disabilities. Others are highly intelligent and able to live independently. Wherever your child falls on the spectrum, getting an autism diagnosis is a two-stage process, and it starts with your pediatrician. The ambitions were to create a screening system independent from parental awareness regarding their children's development. High demands are required for a screening system designed to be performed on children without any previous suspicion of any developmental abnormalities. The benefits of early ASD detection must be weighed against the risk for false positive test results causing parents unnecessary worry.

## ACKNOWLEDGEMENT

Authors would like to express deepest gratitude towards Universiti Teknikal Malaysia Melaka (UTeM), Center for Research and Innovation Management (CRIM), Centre for Advanced Computing Technology (C-ACT), Pervasive Computing & Educational Technology (PET) and everyone who have helped and participated in this study. Thanks for sponsor the publication fees from Research Grant PJP/2019/CRIM (3D) S01686, Universiti Teknikal Malaysia Melaka (UTeM).



## REFERENCES

- Baio J., Wiggins L., Christensen D., Maenner M., Daniels, J., Warren Z., Kurzius-Spencer M. 2018. Prevalence of autism spectrum disorder among children aged 8 years - Autism and developmental disabilities monitoring network, 11 sites, United States, 2014. *Morbidity and Mortality Weekly Report Surveillance Summaries*. 67, 1-23.
- Dawson G, Rogers S, Munson J, Smith M, Winter J, Greenson J, *et al.* 2010. Randomized controlled trial of an intervention for toddlers with autism: The Early Start Denver Model. *Pediatrics*. 125: 17-23.
- Dawson G. & Burner K. 2011. Behavioral interventions in children and adolescents with autism spectrum disorder: A review of recent findings. *Current Opinion in Pediatrics*. 23(6): 616-620.
- Faras, H.; AlAteeqi, N.; Tidmarsh, L. Autism spectrum disorders. 2010. *Ann. Saudi. Med.* 30, 295 - 300. Autism spectrum disorders. *Annal of Saudi Medicine*.
- Filipek P., Accardo P., Ashwal S., Baranek G., Cook E., Dawson G., Volkmar F. 2000. Practice parameter: Screening and diagnosis of autism: Report of the quality standards subcommittee of the American Academy of Neurology and the Child Neurology Society. *Neurology*. 55(4): 468-479.
- Haglund N, Dahlgren SO, Källén K, Gustafsson P, Råstam M. 2015. The Observation Scale for Autism (OSA): A New Screening Method to Detect Autism Spectrum Disorder before Age Three Years. *Intellect Disable Deign J.* 3: 230-237.
- Johnson CP, Myers SM, 2007. American Academy of Pediatrics Council on Children with Disabilities. Identification and evaluation of children with autism spectrum disorders. *Pediatrics*. 120:1183.
- Mazurek MO Vasa RA, Mahajan R. 2017. Assessment and treatment of anxiety in youth with autism spectrum disorders. *Pediatrics*. 137:S115-23.
- Nadel S. & Poss J. 2007. Early detection of autism spectrum disorders: Screening between 12 and 24 months of age. *Journal of American Academy of Nurse Practitioners*. 19, 408-417.
- National Collaborating Centre for Women's and Children's Health. 2011. Autism: recognition, referral and diagnosis of children and young people on the autism spectrum [Internet]. London: RCOG Press. (NICE clinical guideline).
- Oosterling IJ, Swinkels SH, van der Gaag RJ, Visser JC, Dietz C, Buitelaar JK. 2009. Comparative analysis of three screening instruments for autism spectrum disorder in toddlers at high risk. *J Autism Dev Disord*. 39: 897-909.
- Perrin JM, Erikson-Warfield M, Zwaigenbaum, L. 2016. Health care for children and youth with autism and other neurodevelopmental disorders. *Pediatrics*.
- Lord C, Risi S, DiLavore PS, Shulman C, Thurm A, Pickles A. 2006. External Autism from 2 to 9 years of age. *Arch Gen Psychiatry*. Jun. 63(6):694-701.
- Robins DL. 2008. Screening for autism spectrum disorders in primary care settings. *Autism*. 12: 537-556.
- Rogers S. J., & Vismara L. A. 2008. Evidence-based comprehensive treatments for early autism. *Journal of Clinical Child and Adolescent Psychology*. 37(1): 8-38.
- Warren, Z., McPheeters, M. L., Sathe, N., Foss-Feig, J. H., Glasser, A., & Veenstra-Vanderweele, J. 2011. A systematic review of early intensive intervention for autism spectrum disorders. *Pediatrics*, 127(5), e1303–1311.
- Zwaigenbaum L., Bauman M., Choueiri C., Fein D. & Karr S. 2015. Early identification and interventions for autism spectrum disorder: Executive summary. *Pediatrics*. 136(S1): S1-S9.