

Trends in Using Digital Apps to Measure Concentration for Autism: Bibliometric Analysis and Global Visualization

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Abstract: This study has a specific goal of developing a digital application to measure the concentration of autistic children, with the aim of achieving accurate, reliable measurements that can serve as a basis for service or intervention to address concentration problems in autistic children. The research method, using the Systematic Literature Review model, is designed to explore worldwide public trends in the use of digital applications to measure the concentration of autistic children. Data from relevant studies published from 2018 to 2022 were retrieved from the Scopus database via Publish or Perish. The bibliometric analysis technique was used to analyse the resulting data by coupling visual bibliography, co-authorship, co-citation, co-occurrence, and analysis of publication trends of the visualisation of similarity (VOS) software. Research trends show that it is not only used to measure the concentration of autistic children but can be used on all humans, measuring students' psychological problems and as a test for entering work and members of the police or army. Research on concentration measurement has been widely conducted in Europe and the United States. The number of US authors is higher than that of other countries, totaling 708. This indicates the use of concentration measuring instruments widely applied in the country. The research trend revealed by the discovery of 15 journals discussing the measurement of autistic children's concentration can serve as a basis for developing digital applications. Digital applications can measure the concentration levels of autistic children by detecting pupils.

Keywords: autism; digital apps; concentration.

INTRODUCTION

Autistic are children who experience complex developmental disorders with disabilities in various fields, including social communication, gross motor, fine motor, and concentration (APA, 2013). Autism disorders are characterised by disturbances in social interaction, communication and behavioural functions that can affect social development both within the family and school (Payakachat et al., 2012). Children with autism disorders show low concentration (Ridderinkhof et al., 2020). Autistic children have the same concentration problems as typical children but in autistic children. Concentration is easily disturbed quickly due to objects considered interesting by autistic children because they contain motion elements and striking colours. The problem of concentration needs to be overcome because it affects the child's eye contact, which significantly affects the child's ability to understand something in learning at school, which causes the cognitive of autistic children to be low (Ismail et al., 2012).

The relationship between the concentration level of attention and the achievement of understanding of the learning material (McDougal et al., 2020). Children with poorer attention show weakness in learning achievement and understanding of learning in school (McDougal et al., 2020). Measurement of the concentration of autistic children needs to be carried out as a fundamental basis for making service plans or appropriate interventions according to the results of measurements or assessments (Hyman et al., 2019). Accurate measurement results are used to prepare the Individualized Educational Program (IEP) or PPI (Hyman et al., 2019). The IEP aims to provide specific skills to promote conversation and nonverbal communication, such as eye contact, directing facial expressions, and concentrating (Hyman et al., 2019). Using standardised measurements or assessments is not

without limitations, including the lack of sensitivity of some assessments to measure very complex things such as concentration (Ismail et al., 2012; Bacon et al., 2014). Measurement constraints that can affect the level of understanding and achievement of children in school, as well as the lack of information provided by assessments that can be used as a guide in preparing interventions, cause autistic children not to be adequately handled in concentration problems (Bacon et al., 2014).

The importance of applying an assessment tool with adequate psychometric properties for children with autism when assessing the lack of concentration levels using digital applications that can guarantee accuracy, reliability, and interpretability (Andersen et al., 2017; Dawson et al., 2019). The accuracy of the measurement is guaranteed because the application has inputted the programming language with standards for measuring the concentration of autistic children (Major et al., 2020). This ensures that the resulting data follows the existing conditions compared to measurements made by an assessment person. This digital application aims to speed up measurements and improve early detection. The measurement data can be stored digitally, reducing the accumulation of complicated file documents in therapy or school settings (Dawson et al., 2019). Another use of applications on mobile devices in digital form offers convenience for teachers and parents of autistic children to strengthen skills lacking in taking measurements independently at school or home during the COVID-19 pandemic (Montes et al., 2021).

Scientific publications in Scopus journals are the main outputs related to scientific research and can be easily analysed to measure contributions to specific research areas (Mao et al., 2020). Bibliometric analysis and appropriate visual mapping techniques have been used routinely in recent years to assess scientific progress at a high level (Tijssen & Winnink, 2016). This analysis focuses on the quantitative and qualitative evaluation of trends in a particular research community over time-based on data obtained from major online databases (Ekinici et al., 2015), comparing the relative contributions of different scholars, journals, institutions and countries for some regions of interest (Pu et al., 2016).

METHOD

Design Research

In this study, the selected data set was analysed using an exploratory Systematic Literature Review and a bibliometric study that identified and analysed the literature on the use of digital applications to measure the concentration of autistic children. (Álvarez-García et al., 2019). The performance analysis and scientific mapping carried out in the first part of the research are scientific or bibliometric mapping, which represents how disciplines, fields, specialisations, individual papers, and authors are related (Small, 1999). Recommendations from bibliometric results are used to generate maps to discover different research topics and structures in the dataset (Cobo et al., 2011). A second analysis was also performed, sorting the articles in descending order according to the number of citations. Recommendations from (Heradio et al., 2016) were used to complete this part of the study.

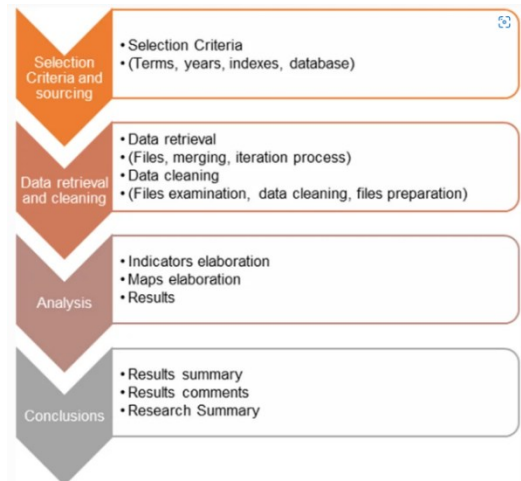


Figure 1. Research procedure (Danvila-del-Valle et al., 2019)

Data Collection

Articles that represent international scientific activities published in scientific journals are analysed (Durán-Sánchez et al., 2018; Velasco et al., 2011). Therefore, papers, editorials, books, chapters, proceedings, news and other documents found in the database are excluded. Data is drawn from relevant studies published from 2013 to 2022, which were taken from Scopus via Publish or Perish.

Identify the Source

Data were collected from Scopus-indexed journal articles. These characteristics justify their use (Durán-Sánchez et al., 2019). The Scopus multidisciplinary bibliographic database was also used to search for information in articles from scientific journals (ASJC) classified into organised hierarchies of fields and subfields (Hassan et al., 2019). This database was selected due to three criteria:

- a. Has a quality index like SJR.
- b. Covering period 2013 – 2022
- c. Have citations and can download the substance of the journal

The search for articles uses Publish or Perish and the Scopus database, which is then processed with VOS, the bibliometric software used for data analysis. The search was limited to articles with the title containing the keyword “measure attention for autism”. This is included in quotation marks to find all documents containing the following keywords: “Autism” AND “Attention” AND “Concentration”.

Data analysis process

This analysis contains bibliographic information obtained after a manual review of 15 relevant documents in the Scopus database. The articles were selected from 1,568, and adjustments were made based on the criteria to address the desired topic: measuring the concentration of children with autism. VOS software was used for data analysis. It is a tool that analyses all the data identified in the body of literature and identifies the main themes (Huber, 2002). This application provides a web interface for Bibliometric or VOS software (Aria & Cuccurullo, 2017) and, if desired, data in graphical format to visualise statistics. In this study, graphs depict the concentration measurements of autistic children during the selected period.

Mapping results using Publish or Perish can summarise research published in journals on measuring concentration or attention in children with autism. Table 2 shows the number of studies from scientific publications in Scopus-indexed journals, totalling 15 articles. The details can be seen in Table 2 below.

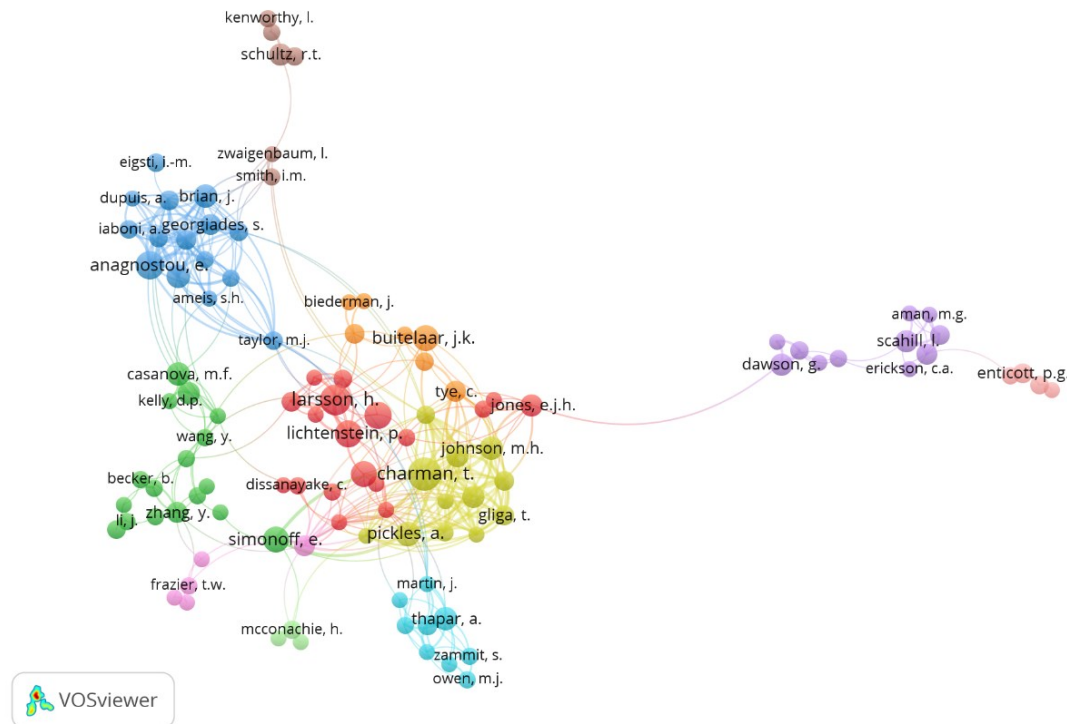


Figure 3. VOS mapping of the number of authors

Table 2. Articles on measuring concentration or attention

Authors	Title	Year	Source	Type
M. Murias	Validation of eye-tracking measures of social attention as a potential biomarker for autism clinical trials	2018	Autism Research	Article
E.M.R. Lake	The Functional Brain Organization of an Individual Allows Prediction of Measures of Social Abilities Transdiagnostically in Autism and Attention-Deficit/Hyperactivity Disorder	2019	Biological Psychiatry	Article
R. Luyster	Neural measures of social attention across the first years of life: Characterizing typical development and markers of autism risk	2014	Developmental Cognitive Neuroscience	Article
A. Navab	Eye-tracking as a Measure of Responsiveness to Joint Attention in Infants at Risk for Autism	2012	Infancy	Article
M. Swanson	Patterns of gaze behaviour during an eye-tracking measure of joint attention in typically developing children and children with autism spectrum disorder	2013	Research in Autism Spectrum Disorders	Article
M. Swanson	Broad autism phenotype in typically developing children predicts performance on an eye-tracking measure of joint attention	2013	Journal of Autism and Developmental Disorders	Article

Authors	Title	Year	Source	Type
S. Vettori	Combined frequency-tagging EEG and eye-tracking measures provide no support for the “excess mouth/diminished eye attention” hypothesis in autism	2020	Molecular Autism	Article
V. Jyoti	Human-Computer Interaction based Joint Attention Cues: Implications on Functional and physiological measures for Children with autism spectrum disorder	2020	Computers in Human Behavior	Article
M. Swanson	Brief report: Broad autism phenotype in adults is associated with performance on an eye-tracking measure of joint attention	2014	Journal of Autism and Developmental Disorders	Article
M. Zayat	Brief report: Performance pattern differences between children with autism spectrum disorders and attention deficit-hyperactivity disorder on measures of verbal intelligence	2011	Journal of Autism and Developmental Disorders	Article
C. Holingue	Links between parent-reported measures of poor sleep and executive function in childhood autism and attention deficit hyperactivity disorder	2021	Sleep Health	Article
N. Bast	Atypical Arousal Regulation in Children With Autism but Not With Attention-Deficit/Hyperactivity Disorder as Indicated by Pupillometric Measures of Locus Coeruleus Activity	2021	Biological Psychiatry: Cognitive Neuroscience and Neuroimaging	Article
I.O. Lee	The electroretinogram b-wave amplitude: a differential physiological measure for Attention Deficit Hyperactivity Disorder and Autism Spectrum Disorder	2022	Journal of Neurodevelopmental Disorders	Article
K. Nayar	A constellation of eye-tracking measures reveals social attention differences in ASD and the broad autism phenotype	2022	Molecular Autism	Article
M. Zhang	Transdiagnostic symptom subtypes across autism spectrum disorders and attention deficit hyperactivity disorder: validated by measures of neurocognition and structural connectivity	2022	BMC Psychiatry	Article

Discussion

The research trend revealed by the discovery of 15 journals discussing the measurement of autistic children's concentration can serve as a basis for developing digital applications. Digital applications can measure the concentration levels of autistic children by detecting pupils. With this continued development, it becomes a novelty from previous research.

The consequences of not handling the concentration problems of autistic children have been explained in Figure 3, which can be concluded to have a significant impact on the learning of autistic children at school. Children will be unable to develop optimally in terms of social, behavioural and intellectual. Teachers need to provide therapy or treatment to overcome the concentration problems of autistic children. The problems of autistic children need to be handled considering the characteristics of autistic children who experience problems with parts of the brain that affect their concentration. Autistic children often experience shrinkage in the cerebellum, which disrupts the flow of impulses in the brain. The cerebellum supports balance and sensory processes, as well as thinking, memory, learning, language, and concentration. The difficulty autistic children have in quickly

concentrating on other things is a characteristic of autism (Rokhimah & Darmawanti, 2013). Another view of concentration is that it is an effort to direct mental activity to specific experiences (Rokhimah & Darmawanti, 2013). This causes Autistic Children to have a huge influence on their cognition. This concentration disorder has a significant impact on the performance of Autistic Children during learning at school (Rokhimah & Darmawanti, 2013).

The condition of Autistic Children who have a short concentration span when carrying out activities or learning must be addressed by assisting them in restoring their concentration to complete activities or learning. One activity that can spur concentration in autistic children is play (Musfiroh, 2014). In play activities, children will be happier and more comfortable, and they will enjoy activities that increase concentration (Musfiroh, 2014). Games that can be used to train concentration are constructive (Musfiroh, 2014).

CONCLUSION

Research trends show that it is not only used to measure the concentration of autistic children but can be used on all humans, measuring students' psychological problems and as a test for entering work and members of the police or army. Research on concentration measurement is widely conducted in Europe and the United States. The number of authors from the United States is higher than that of other countries, totaling 708. This indicates the use of concentration-measuring instruments, widely applied in the country. The research trend revealed by the discovery of 15 journals discussing the measurement of autistic children's concentration can serve as a basis for developing digital applications. Digital applications can measure the concentration levels of autistic children by detecting pupils. With this continued development, it becomes a novelty from previous research.

REFERENCES

- American Psychiatric Association. (2013). *Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5)*. Washington, DC: American Psychiatric Publishing.
- Andersen, P.N., Hovik, K.T., Skogli, E.W., Øie, M.G. (2017). Severity of autism symptoms and degree of attentional difficulties predict emotional and behavioral problems in children with high-functioning autism: A two-year follow-up study. *Frontiers in Psychology*, 8(2):1–9. DOI: 10.3389/fpsyg.2017.02004
- Bacon, E.C., Dufek, S., Schreibman, L., Stahmer, A.C., Pierce, K., Courchesne, E. (2014). Measuring outcome in an early intervention program for toddlers with autism spectrum disorder: Use of a curriculum-based assessment. *Autism Research and Treatment*, 1 – 9. DOI: 10.1155/2014/964704
- Dawson, G., & Sapiro, G. (2019). Potential for digital behavioral measurement tools to transform the detection and diagnosis of autism spectrum disorder. *JAMA Pediatrics*, 173(4), 305–316. DOI: 10.1001/jamapediatrics.2018.5269
- Ekinci, S., Agilli, M., Ersen, O., & Ekinci, G. H. (2015). Letter to the editor regarding analysis of changing paradigms of management in 179 patients with spinal tuberculosis during a 12-year period and proposal of a new management algorithm. *World Neurosurgery*, 84(6), 2072.
- Hu, Hz., Feng, Xb., Shao, Zw. et al. Application and Prospect of Mixed Reality Technology in the Medical Field. *Current Medical Science*, 39, 1–6.
- Ismail, L.I., Shamsudin, S., Yussof, H., Hanapiah, F.A., Zahari, N. (2012). Estimation of concentration by eye contact measurement in a robot-based intervention program with autistic children. *Procedia Engineering*, 41(1):1548–52.

- Major, S., Campbell, K., Espinosa, S., Baker, J.P., Carpenter, K.L.H., Sapiro, G., Vermeer, S., Dawson, G. (2020). Impact of a digitally modified checklist for autism in toddlers-revised on the likelihood and age of autism diagnosis and referral for developmental evaluation. *Autism*, 24(7):1629–1638. DOI: 10.1177/1362361320916656
- Mao, X.M.S., Guo, L. M.S.B., Fu, P. M.D., Xiang, C. M.D. (2020). The status and trends of coronavirus research: A global bibliometric and visualized analysis. *Medicine*, 99(22), p e20137
- McDougal, E., Riby, D.M., Hanley, M. (2020). Profiles of academic achievement and attention in children with and without autism spectrum disorder. *Research in Developmental Disabilities*, 106(2):1–10.
- Montes, C. P. G., Fuentes, A.R., Cara, M.J. C. (2021). Apps for people with autism: Assessment, classification and ranking of the best. *Technology in Society*, 64.
- Musfiroh, T. (2014). *Bermain dan Permainan Anak [Playing and Children's Games]*. Jakarta:Universitas Terbuka.
- Hyman, S. L., Levy, S. E., Myers, S. M. (2020). Identification, evaluation, and management of children with autism spectrum disorder. *Pediatrics*, 145(1), e20193447. DOI: 10.1542/peds.2019-3447
- Payakachat, N., Tilford, J.M., Kovacs, E., Kuhlthau, K. (2012). Autism spectrum disorders: a review of measures for clinical, health services, and cost-effectiveness applications. *Expert Review of Pharmacoeconomics & Outcomes Research*, 12(4), 485–503.
- Pu, Q., Lyu Q., Su, H. (2016). Bibliometric analysis of scientific publications in transplantation journals from Mainland China, Japan, South Korea, and Taiwan between 2006 and 2015. *BMJ Open*, 6(8): p. e011623
- Ridderinkhof, A., de Bruin, E.I., van den Driesschen, S., Bögels, S. M. (2018). Attention in children with autism spectrum disorder and the effects of a mindfulness-based program. *Journal of Attention Disorders*, 24(5), 681–92.
- Rokhimah, Rina., Darmawanti, Ira. 201. Pengaruh Permainan Lasy Terhadap Peningkatan Konsentrasi pada Anak Autis [The Effect of Lasy Games on Improving Concentration in Children with Autism]. *Jurnal Psikologi Teori & Terapan*, 4(1): 48-55.
- Tijssen, R.J.W., Winnink, J. (2016). Twenty-first-century macro-trends in the institutional fabric of science: bibliometric monitoring and analysis. *Scientometrics*, 109, 2181–2194. DOI: 10.1007/s11192-016-2015-2